

THE TAXONOMIC STATUS OF THE EARTHWORM FAUNA OF LAKE PEDDER, TASMANIAN WILDERNESS WORLD HERITAGE AREA

– with the description of three new genera and fourteen new species

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ABSTRACT

This paper describes a total of 21 oligochaete taxa, mostly collected during a survey in early 1996 of the shorelines and surrounding areas of Lake Pedder in the Tasmanian Wilderness World Heritage Area. These consist of two known and fourteen new megascolecid species that belong to eight endemic genera: *Vesiculodrilus*, *Diporochaeta*, *Perionychella*, *Hypolimnus* gen. nov., *Notoscolex*, *Aprodrilus* gen. nov., *Gastrodrilus* gen. nov. and *Anisochaeta*. The new genus *Gastrodrilus* presents a particularly interesting morphological adaptation of multiple intestinal gizzards, numbering up to ten in series. Five introduced megadrile species were also found (four lumbricids—one a new record for Australia, plus the megascolecid *Anisochaeta dorsalis* (Fletcher, 1887)—this the first record of an introduced native earthworm from Victoria). These findings attest to the high diversity and endemism of oligochaetes in Tasmania, Lake Pedder having the highest number of native species described from any site surveyed thus far.

The purpose of the survey was to determine the conservation and taxonomic status of Lake Pedder earthworms, particularly the only earthworm species previously described from this locality: one collected from the original lake's edge prior to its hydro-electric impoundment in 1972. Reinspection of the type, and only, specimen of *Perionychella* (*Vesiculodrilus*) *pedderensis* Jamieson, 1974 showed that it had been inadequately described, was probably of local derivation and was sufficiently unique to warrant separate generic status, in monotypic *Hypolimnus* gen. nov. Although several of the new species described herein appear closely related, occupy a similar habitat or superficially resemble *H. pedderensis*, none is conspecific. It is therefore concluded that its inclusion on Schedule 3 of the Tasmanian Threatened Species Protection Act, 1995 is warranted. Most probably *H. pedderensis* is extinct through loss of its original and unique habitat and, if so, this is the first instance of loss of an endemic earthworm species from the world fauna.

INTRODUCTION

Lake Pedder lies at the accessible heart of the largely undisturbed Tasmanian Wilderness World Heritage Area (TWWHA) which encompasses over 1.38 million hectares of west and south-west Tasmania (~ 20% of the state). Prior to its flooding for hydro-electric power in 1972, the original lake was regarded as the only significant Australian example of a glacial outwash impoundment and was notable for the large quartzite beach formed at its eastern end that had unique faunal associations (Bayly et al., 1966, 1972; Bayly, 1973). Driessen (1999) details the known invertebrate species threatened by this flooding and summarises wider conservation issues of the TWWHA. Oligochaeta recorded from around the original lake included several tubificid and phreodrilid microdriles (see Brinkhurst and Fulton, 1979) and one megadrile earthworm, *Perionychella* (*Vesiculodrilus*) *pedderensis* Jamieson, 1974. The Lake Pedder earthworm was subsequently considered likely to be extinct due to loss of its original habitat through inundation and was listed as an

endangered species (Anon, 1994) under the Red List criteria of the IUCN (1994, 1996). This conclusion was based partly on a survey conducted by Dyne (1991), as neither of the specimens he collected agreed with the description of the Lake Pedder earthworm.

Of the forty-seven indigenous species of earthworms described from Tasmania prior to 1996 (Spencer, 1895; Jamieson, 1974), twelve (~25%) were located in or adjacent to the TWWHA. The conservation status of many of these earthworms is uncertain, not least because of taxonomic inadequacies imposed by limited available material and by errors and ambiguities in previous descriptions. Records of described TWWHA species prior to the present survey are summarised below (with numbers of specimens) given their original, but rarely correct, generic identifications:

- (1) *Perionychella* (*Vesiculodrilus*) *pedderensis* Jamieson, 1974—Lake Pedder (monotypic), believed to be extinct.

- (2) *Perionychella (Vesiculodrilus) obliquae* Jamieson, 1974—from Interview River (two specimens, one a posterior amputee) and Port Davey. The single Port Davey specimen was found, on reinspection by the present author, to be a different species actually closer to *Perichaeta dilwynnia* Spencer, 1895 (Blakemore, in prep.).
- (3) *Perionychella (Perionychella) hickmani* Jamieson, 1974—recorded from north-west Tasmania (three specimens) and from Lake St Clair (three specimens). New material has recently been collected by the present author from the latter locality that questions the distinction of this species from the prior *Perichaeta richea* Spencer, 1895 (see below).
- (4) *Perionychella (Vesiculodrilus) evansi* Jamieson, 1974—from Lake St Clair. The type description was based on two damaged specimens, therefore some taxonomic ambiguity surrounds this species.
- (5) *Perichaeta richea* Spencer, 1895—from Mt Olympus, Lake St Clair. Anomalies in the original description caused Jamieson (1974) to regard this as a *species dubium*. Although type material is missing (Jensz & Smith, 1969), new material corresponding to the type description has recently been found from the type locality that helps resolve this impasse (Blakemore, in prep.).
- (6) *Perichaeta moroea* Spencer, 1895—from Lake St Clair district. The type material in the Museum of Victoria is still in good condition, its inspection and redescription by the present author allows ambiguities in the type description to be resolved (Blakemore, in prep.).
- (7) *Cryptodrilus avesciculatus* Jamieson, 1974—from Port Davey (three specimens) and New Harbour (four specimens). New material from Port Davey has been identified by the present author that indicated a distinctiveness of this taxon from parts of a *Cryptodrilus polynephricus* complex (*vide intra Apodrilus* gen. nov.).
- (8) *Cryptodrilus dartnalli* Jamieson, 1974—from Port Davey (holotype posterior amputee, paratype) and New Harbour (five specimens). Inadequately described (*vide intra Gastrodrilus* gen. nov.), conservation status unknown.
- (9) *Cryptodrilus wellingtonensis* Spencer, 1895—type locality, Hobart. A single specimen collected by Mr C. D. King in 1940 from Port Davey and described as new material by Jamieson (1974) differed considerably from the original type description and is unlikely to be conspecific (Blakemore, in prep.).
- (10) *Cryptodrilus tessellatus* Spencer, 1895—from Mt Olympus, Lake St Clair, type material missing from Museum of Victoria (Jensz & Smith, 1969); not subsequently rediscovered, thus the conservation status is unknown.
- (11) *Oreoscolex sexthecatus* Jamieson, 1974—from Lake St Clair, imperfectly known as the type description was based on a single, immature, macerated, posterior-amputee, heavily infested with

protozoan parasites that may actually be referable to *Cryptodrilus officieri* Spencer, 1895 (Blakemore in prep.).

- (12) *Perichaeta scolecoidea* Spencer, 1895—originally from King River Valley, parts of which are now also inundated. The type material is refractory, however new material from Lake St Clair indicates that this species has a wider distribution (Blakemore in prep.).

The results of systematic surveys and taxonomic research relating to Tasmanian earthworms, including inspection of all available type material of the above taxa, are currently in various stages of publication (e.g. Blakemore, 1997a, 1998, 1999, 2000, and in prep.). The present report concentrates on terrestrial earthworms from the Lake Pedder region. Several aquatic microdrile specimens that were found during the present survey, appearing to belong to at least three different taxa, will be passed on to Adrian Pinder for identification.

METHODOLOGY

One week's survey of the area around Lake Pedder, similar to previous surveys of the region (e.g. Bayly, 1973; Dyne, 1991), was conducted in April 1996 (Blakemore, 1996). As mainly qualitative samples were sought, the numbers of specimens of a taxon alone give an indication of its relative abundance. The primary purpose was to assess the biodiversity and to resolve taxonomic uncertainties of known species in an attempt to determine the conservation status of the fauna, this being an essential prerequisite for effective management plans. Discussion on systematics and distribution is limited to remarks accompanying species descriptions. For ease of comparison, the systematic section here commences with generic diagnoses pertinent to the current account, followed by species descriptions. The rationale underlying generic review is that any derivation from plesiomorphic character states (those known to occur in 'primitive' taxa) are regarded as apomorphies. Thus, tubular prostates (i.e. elongate glands with simple unbranched central canal), holoic nephridia (i.e. two per segment) and lumbricine setae (i.e. eight per segment) are considered plesiomorphic. This is consistent with Michaelsen (1907), Stephenson (1930) and with Jamieson (1988).

Conventions

Segments are counted in Arabic numerals, intersegments designated by a slash (e.g. 1/2), variations shown by a comma, and range by a dash (e.g. 3,4–5). Setae, counted from the ventralmost on each side, have lower case letters (e.g. a, b, c, d) and ranges are shown without a space (e.g. ab); setal lines refer to longitudinal setal series. (Lumbricine species have setal ratios illustrated for segment 12). Specimens were dissected by dorsal incision. Abbreviations lhs and rhs are for left- and right-hand-side from the observer's point of view. All new material is lodged in the Queen Victoria Museum, Launceston (QVM registration numbers beginning 14:);

Tasmanian Museum specimens are prefixed TM: K, Australian Museum specimens AM: W; Muscum of Victoria NMV; and British Museum (Natural History) specimens BM:. Holotype and paratypes are (H) and (P), respectively. Australian states are NSW, New South Wales; WA, Western Australia. Grid references are standard AMG (eastings and northings) obtained from maps, determined using a handheld GPS, or are as originally stated. Newly collected specimens were anaesthetised in dilute ethanol before being fixed in 10% formalin overnight and are preserved in 80% ethanol in labelled jars. Original *camera lucida* drawing by the author have scale bars of 1 mm.

RESULTS

Systematics, generic diagnoses

FAMILY MEGASCOLECIDAE

Genus *Vesiculodrilus* Jamieson, 1973 s. strict.

Vesiculodrilus Jamieson, 1973, pp. 224–25

Perionychella (*Vesiculodrilus*) (part.) Jamieson, 1974, pp. 216–25

Diporocheata Beddard, 1890 (part.); Jamieson, 1976, pp. 4–11

Pinguidrillus Jamieson, 1974, p. 263

Diagnosis: Setae eight per segment. Combined pores of vasa deferentia and tubular prostates paired on 18. Gizzard in 5; extramural calciferous glands absent; typhlosole absent. Nephridia holoic with terminal dilations of the ducts forming large bladders; nephropores in a single row on each side near c lines. Spermathecae five or fewer pairs with single, uniloculate diverticula.

Type species: *Cryptodrilus frenchi* Spencer, 1892 from Victoria.

Distribution: Victoria, southern NSW, Tasmania.

Remarks: This genus was erected by Jamieson (1973) as defined above except that only five pairs of spermathecae were allowed. For taxonomic 'convenience', Jamieson (1974, p. 218) reduced *Vesiculodrilus* to a sub-genus in *Perionychella* Michaelsen, 1907 which itself had been 'suppressed for nearly sixty years' in *Diporocheata*. While re-instating Michaelsen's genus, Jamieson (1974) re-defined it, ignoring variations in setae and prostates (and therefore encompassing not only *Diporocheata*, a prior genus, but also several other genera). Subsequently, Jamieson (1976) reassigned *Perionychella* s. Jamieson (1974), and presumably all subordinate genera, to *Diporocheata* s. Jamieson (1976). *Pinguidrillus* is synonymised following the author's discovery of spermathecal diverticula in the lectotype of the type species in the Museum of Victoria, and in all other specimens, thereby removing justification for this genus (Blakemore, in prep.).

Here *Vesiculodrilus* is reinstated with its original designation for lumbricine species with tubular prostates and characteristic vesiculate holonephridia. Consideration is restricted above to a brief generic diagnosis as full accounts of the species are currently in preparation. The species in this genus show high morphological similarities and are proving to be particularly diverse in Tasmania (whence approximately 68 new species have been identified by the present author). Related vesiculate genera in the eastern subregion of mainland Australia are *Plutellus* Perrier, 1873 (see Blakemore, 1994) which, unlike *Vesiculodrilus*, has regular alternation of nephropores and extramural calciferous glands, and *Fletcherodrilus* Michaelsen, 1891 that typically has unpaired male and spermathecal pores.

Holoic species (with or without nephridial bladders) attaining greater than eight setae per segment (the perichaetine condition) are assignable to *Diporocheata* s. strict. if they have tubular prostates, or to *Perionychella* s. strict. when their prostates are other than tubular (i.e. tubuloracemose or racemose). Avesiculate holoic species with racemose prostates and 8 setae per segment are placed in *Woodwardiella* Stephenson, 1925.

Genus *Diporocheata* Beddard, 1890 s. strict.

Diporocheata Beddard, 1890, pp. 55, 56; 1895, p. 439; Michaelsen, 1900, pp. 199–200; 1907, pp. 160, 161; Stephenson, 1930, p. 840; Lee, 1959, pp. 262–63; Gates, 1959, p. 254

Perionychella (part.); Jamieson, 1974, pp. 216–21

Diporocheata (part.); Jamieson, 1976, pp. 4–11

Diagnosis: Setae more than eight per segment, at least in the mid- and hindbody. Male pores paired on 18, combined with pores of tubular prostates. Gizzard in 5 or 6; extramural calciferous glands present or absent; typhlosole absent. Nephridia holoic (with or without bladders), often tufted in anterior segments. Spermathecae five or fewer pairs; diverticula uniloculate.

Type species: *Perichaeta intermedia* Beddard, 1889 from New Zealand.

Distribution: Victoria, Tasmania, southern NSW, New Zealand, ?southern India.

Remarks: The generic diagnosis reverts to the 'classical' concept established by Michaelsen (1900) and adopted by Stephenson (1930) and Lee (1959), rather than the wider definition proposed by Jamieson (1976). Full revision is beyond the scope of the current study.

Genus *Perionychella* Michaelsen, 1907 s. strict.

Perionychella Michaelsen, 1907, pp. 160, 163

Perionyx (part.) ; Michaelsen, 1916, p. 7; Stephenson, 1930, p. 841; Lee, 1959, pp. 318–19; Gates, 1959, p. 254

Perionychella (part.) ; Jamieson, 1974, pp. 216–23

Diporocheata (part.) ; Jamieson, 1976, pp. 4–11

Diagnosis: Setae more than eight per segment, at least in the mid- and hindbody. Male pores from tubuloracemose or racemose prostates paired on 18. Gizzard developed in 5 (or 6?); extramural calciferous glands absent; typhlosole absent. Nephridia holoic (with or without bladders), often tufted in anterior segments. Spermathecae five or fewer pairs; diverticula single, uniloculate.

Type species: *Perichaeta dendyi* Spencer, 1893 from Victoria.

Distribution: Victoria, Tasmania, southern NSW, Queensland, New Zealand.

Remarks: The generic definition above complies with Michaelsen's original.

Genus *Hypolimnus* gen. nov.

Diagnosis: Setae more than eight per segment. Male pores from tubuloracemose prostates paired on 18. Multiple oesophageal gizzards in 5–6, 1/7; extramural calciferous glands absent; typhlosole absent. Dorsal pores present but reduced. Nephridia vesiculate holoic. Spermathecae four pairs; diverticula single, uniloculate.

Type species: *Perionychella (Vesiculodrilus) pedderensis* Jamieson, 1974; p. 251.

Distribution: Lake Pedder, Tasmania.

Remarks: *Hypolimnus* is defined principally on the autapomorphic multiplication of oesophageal gizzards, that are apparently unique to this perichaetine, holoic megascolecid. The reduced dorsal pores are another feature of this genus. Were it not for these gizzards, the monotypic type species would comply with *Perionychella* as defined above. Multiple gizzards in some or all of 5–7 are found in *Digaster* Perrier, 1872, *Didymogaster* Fletcher, 1886 and *Perrisogaster* Fletcher, 1887; however, these three mainland Australian genera are lumbricid and meroic (see Blakemore, 1997b).

Etymology: 'hypolimnus' beneath the lake.

Genus *Notoscolex* Fletcher, 1886

Notoscolex Fletcher, 1886, p. 546

Notoscolex + *Megascolides* (part.); Michaelsen, 1900, p. 187

Notoscolex (part.); Stephenson, 1930, p. 836

Notoscolex; Michaelsen, 1907, pp. 160–62; Lee, 1959, p. 317; Gates, 1959, p. 254; Jamieson, 1973, pp. 236, 239; Blakemore, 1997a, pp. 1688–89

Pseudonotoscolex Jamieson, 1971, p. 496

Oreoscolex (part. ?); Jamieson, 1973, pp. 215–52; 1974, pp. 302–03

Diagnosis: Setae eight per segment. Male pores from racemose (or tubuloracemose) prostates paired on 18. An oesophageal gizzard in 5 or 6. Nephridia meroic, at least in the fore-body, avascular, sometimes tufted. Dorsal pores present. Typhlosole typically absent; extramural calciferous glands typically present; intestinal caeca absent. Penial setae typically present. Spermathecae two or three pairs (or, in *Oreoscolex* type, unpaired?), with multiloculate sessile (or one or more clavate) diverticula.

Type species: *Notoscolex camdenensis* Fletcher, 1886 from NSW.

Distribution: NSW, Victoria, Tasmania, WA, (?New Zealand, South India, Sri Lanka).

Remarks: The above definition is based on that of Michaelsen (1907) and Stephenson (1930). As discussed by Blakemore (1997a), the attainment of nephridial bladders serves to separate *Cryptodrilus* Fletcher, 1886 from the prior genus *Notoscolex*. No attempt can be made here to fully revise this large genus (Jamieson, 1981 provides a checklist of thirty-eight Australian *Notoscolex* species, some subsequently returned to *Cryptodrilus*). However, in the Tasmanian fauna an apparent morphological (and geographical) distinction is emerging of species that comply with the above diagnosis and those, principally lacking dorsal pores, that conform to *Aporodrilus* gen. nov.

Genus *Aporodrilus* gen. nov.

Diagnosis: Setae 8 per segment. Male pores from tubuloracemose prostates paired on 18. Female pores paired or single. An oesophageal gizzard large in 5. Nephridia meroic, at least in the fore-body, avascular. Dorsal pores absent. Intestine commencing in 16; typhlosole absent; extramural calciferous glands absent; intestinal caeca absent. Penial setae present or absent. Spermathecae two pairs, with clavate or multiloculate but not sessile diverticula.

Type species: *Aporodrilus dombrovskisi* sp. nov from Lake Pedder, Tasmania.

Known Tasmanian species:

Cryptodrilus avascularis Jamieson, 1974

Cryptodrilus brunyensis Jamieson, 1974

Cryptodrilus enteronephricus Jamieson, 1974

Aporodrilus monogynus sp. nov.

Aporodrilus rubicundus sp. nov.

Cryptodrilus polynepluricus urethrae (part.) Jamieson, 1974, herein designated as *Aporodrilus urethrae* comb. nov. (see Remarks following *A. monogynus* description below)

Distribution: South and south-east Tasmania.

Remarks: *Aporodrilus* is separated from *Notoscolex* principally on its lack of dorsal pores and, secondarily, its tubuloracemose prostates and intestinal origin in 16.

Cryptodrilus as defined by Jamieson (1974) included species with tubular prostates—this never part of previous definitions—and species with or without nephridial bladders (despite Jamieson, 1972b having shown that the type species of *Cryptodrilus* had bladders), and with or without dorsal pores. In the current classification, vesiculate forms only are allowed in *Cryptodrilus*, now restricted to a few species, while avesiculate species conform to either *Notoscolex* or to *Aporodrilus*.

Etymology: 'aporodrilus' worm lacking (dorsal) pores.

Genus *Gastrodrilus* gen. nov.

Diagnosis: Setae eight per segment. Male pores from tubuloracemose prostates paired on 18. Female pores paired. Oesophageal gizzard in 5; intestinal gizzards moniliform in most or all of 22–31 (i.e. seven to ten of). Nephridia avesiculate meroic. Dorsal pores absent. Intestine commencing in 16; typhlosole absent; extramural calciferous glands absent; intestinal caeca absent. Penial setae present. Spermathecae two pairs, with clavate diverticula.

Type species: *Gastrodrilus driesseni* sp. nov. from Lake Pedder.

Other Tasmanian species: *Cryptodrilus dartnalli* Jamieson, 1974? (Part of the type material was found by the present author to have intestinal gizzards, but full species redescription is pending).

Distribution: Lake Pedder (and Port Davey?), Tasmania.

Remarks: Moniliform intestinal gizzards, numbering between seven and ten, are a unique and remarkable adaptation in *Gastrodrilus*. Although a similar arrangement (but with between five or six intestinal gizzards) is found in *Nexogaster* Blakemore, 1997a, this genus differs in having dorsal pores and an intestinal origin in 18. *Gastrodrilus* may be derived from *Aporodrilus* (above) through its apomorphic acquisition of intestinal gizzards, in the same way that *Nexogaster* may be derived from *Notoscolex*. Other Tasmanian genera with intestinal gizzards are *Retrovatescus* Blakemore, 1998 (type species *R. plumleyi*) and *Hickmaniella* Jamieson, 1974 (as reviewed by Blakemore, 1997a). However, both of these genera are perichaetine (unlike *Gastrodrilus*) and may therefore be derived from *Anisochaeta*.

Etymology: 'gastrodrilus' gizzard worm.

Genus *Anisochaeta* Beddard, 1890

Megascolex (part.); Beddard, 1890, p. 56; 1895, p. 381; Michaelsen, 1900, pp. 212–16; 1907, p. 163; Stephenson, 1930, p. 837; Jamieson, 1974, pp. 318–19

Perichaeta (part.); Beddard, 1890, p. 56

Anisochaeta Beddard, 1890, p. 56; Blakemore, 1997a,

pp. 1685–86; 1997b, pp. 1822–24; 2000, pp. 2–3

Trichaeta Spencer, 1900, pp. 30–31

Spenceriella (part, including type species?) Michaelsen, 1907, pp. 160–61; Jamieson, 1972a

Gemascolex Edmonds and Jamieson, 1973, pp. 23–24

Diagnosis: Setae more than eight per segment, at least in the mid- and hind-body. Male pores from tubuloracemose or racemose prostates paired on 18. An oesophageal gizzard in 5 (or 6). Nephridia meroic, at least in the fore-body, avesiculate, often tufted in the anterior. Calciferous glands and typhlosole present or absent; intestinal caeca and gizzards absent. Penial setae present or absent. Spermathecae two to five pairs (sometimes unpaired?), with extramural diverticula.

Type species: *Perichaeta coxii* Fletcher, 1886, from NSW.

Distribution: Australia (according to Beddard, 1890).

Remarks: *Anisochaeta* is the next available genus, defined to accommodate Australian species, once *Megascolex* is restricted to megascolecids lacking extramural diverticula (as in its Indian type species *M. caeruleus* Templeton). (Arguments for this decision are given in Blakemore, 1997a; 1997b). *Perichaeta* has long been subsumed (e.g. Stephenson, 1930) whereas several members of the other genera synonymised above require extensive revision, a task beyond the scope of the present paper. *Gemascolex* complies with the diagnosis above and its synonymy with *Anisochaeta* has been advocated by Blakemore (1997a; 1997b; 2000.).

Species descriptions

Vesiculodrilus borealis sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3478, (H) Spent Basin, Lake Pedder, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore, in loam under Ti-tree / Banksia, (mature specimen, dissected and figured, fig. 1).

PARATYPES:

- 14:3471 (P1), same details as H, (mature, dissected and figured, fig. 2).
 14:3479 (P2), same details as H, (mature, posterior amputee).
 14:3480 (P3), same details as H, (mature, posterior amputee, dissected).
 14:3486 (P4), Bell Basin, Lake Pedder, 419600 5259700, 310 m, 9.4.1996, R. J. Blakemore, in loam, (mature, dissected).
 14:3487 (P5), same details as (P4), (mature).
 14:3488 (P6–8), same details as (P4), (3 matures, one a posterior amputee, dissected).

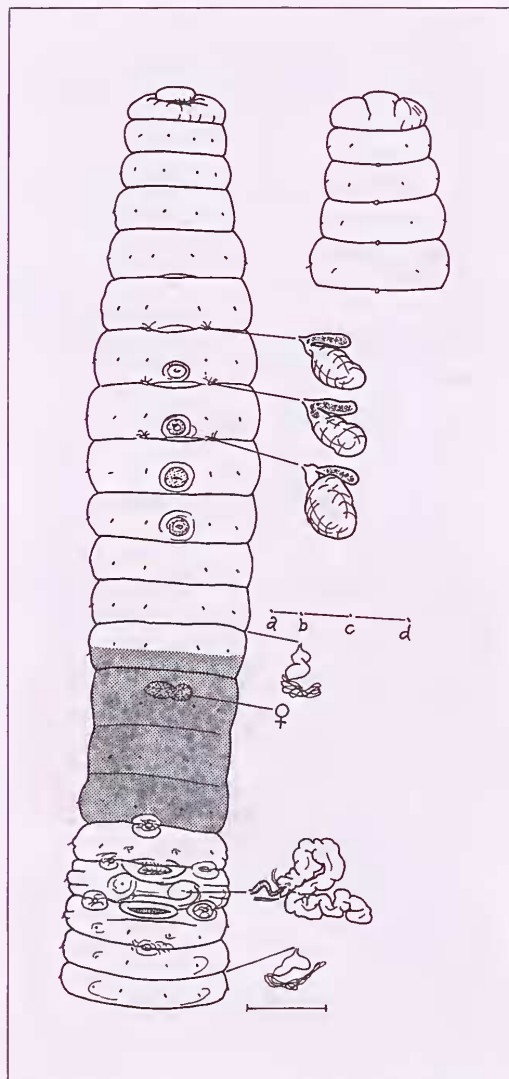


Figure 1. *Vesiculodrilus borealis* sp. nov. Ventral view of (H) showing *in situ* spermathecae, nephridial bladders of 13rhs and 21rhs, prostate ducting to male pores with penial setae; plus dorsal view of prostomium showing dorsal pores.

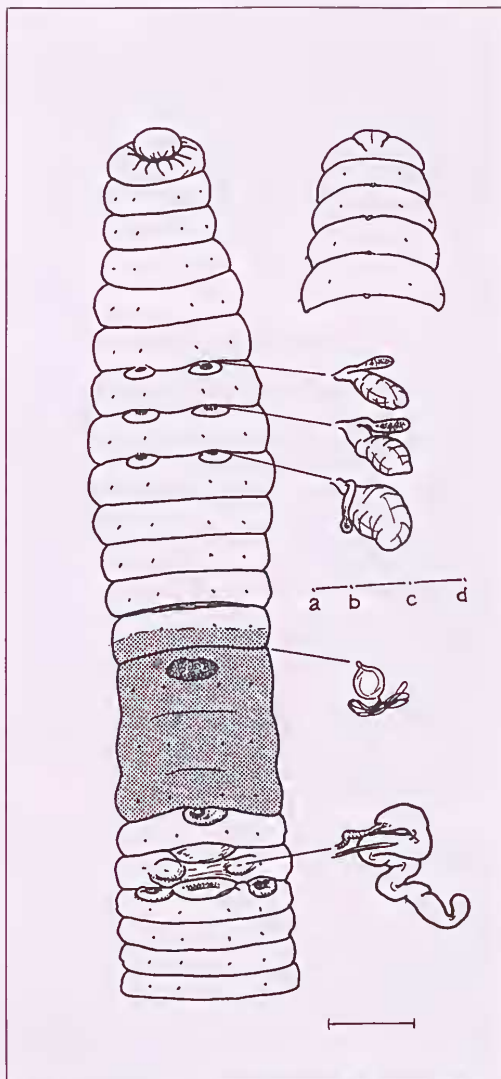


Figure 2. *Vesiculodrilus borealis* sp. nov. Ventral view of (P1) showing *in situ* spermathecae, nephridial bladders of 14rhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores.

- 14:3489 (P9–11), same details as (P4), (2 matures, one a posterior amputee plus an immature and an unregistered tail).
- 14:3500 (P12–15), same details as (H), (3 subadults—two posterior amputees, and an immature).
- 14:3472 (P16–18), same location as H, (two subadults and an immature plus 3 unregistered tails).
- 14:1261 (P19–20), Tram Road Picnic area, Wynyard, north-west Tasmania, 389200 5457200, 34 m, 19.4.1993, R. D. D'Orazio and D. E. Soccol, (2 mature specimens, both dissected).

EXTERNAL FEATURES

Body slightly flattened dorso-ventrally, first segment sometimes compressed, tail blunt. Lengths mm: (H) 60, (P1) 45, (P4) 45, (P5) 45, (P6–7) 30–40, (P10) 40, (P19–20) c. 40, (immatures, c. 30–40 mm). Width: c. 1.5 mm. Segments: (H) 138, (P1) 128, (P19–20) 91. Colour: anterior and dorsum light brown or puce with darker mid-dorsal line, ventrum pale, clitellum pale; or white throughout (P19–20, bleached in alcohol?). Prostomium: open epilobous. Clitellum: $\frac{1}{2}$ 13–16. Dorsal pores: from $\frac{2}{3}$ (rudimentary in $\frac{1}{2}$?). Setae: 8 in regular rows although c and d migrate dorsally in posterior (so that dd = cd) and some d setae are irregular in the tail (but no

setae added). Nephropores: in c lines. Spermathecal pores: 6/7/8/9 just lateral of setal a lines (diverging slightly). Female pores: paired on 14. Male pores: paired on small porophores in ab. Genital markings: single mid-ventral, postsetal discs in some of 6–10 (H, P3, P9–10, P19–20); or paired pre-setal below spermathecal pores in 7,8–9 (P1, P2, P5–7, P17), or paired mid-ventral pre-setal in 7–9 (P4, P8); mid-ventral discs in most specimens in 16/17; tumid pads in all specimens in aa in 17/18 and 18/19, paired discs wider than male pores in b lines in 17/18 (H, P8, P9–10) and/or 18/19 (all mature specimens except P4, P19–20); a midventral disc in 19/20 (H, P9). (No paired genital markings in 19/20 nor 20/21).

INTERNAL ANATOMY

Septa: none especially thickened. Gizzard: large, barrel-shaped in 5. Oesophagus: pale and smooth walled (but not muscular) in 6 and 7; increasingly vascularised and dilated in 8–15, especially 14 and 15; narrowing and valve-like in 16. Nephridia: vesiculate holoic in c lines; bladders elongate in the anterior but broader after the clitellum (becoming ocarina-shaped or perhaps diverticulate); not tufted anteriorly. Vascularization: hearts in 10–12 from weak supra-oesophageal vessel in (8–) 10–12, $\frac{1}{2}$ 13. Spermathecae: 3 pairs in 7–9, saccular ampulla tapering to duct with simple diverticulum ectally. Male organs: holandric iridescent testes and funnels in 10 and 11 in mucus; seminal vesicles large, racemose in 9 and 12. Ovaries: large, palmate in 13; small ovisacs sometimes noted in 14. Prostates: tubular 18–19; short penial setae present. Intestine: origin 17; no typhlosole; gut contents, organic soil material.

REMARKS

This species is similar to *Vesiculodrilus tunnackensis* (Jamieson, 1974), from Tunnack, in having 3 pairs of spermathecal pores in setal a lines. However, *V. tunnackensis* differs in having first dorsal pores from 4/5, the clitellum extending to 12/13, apparently having only subspherical nephridial bladders, and in the arrangement of the genital markings. In addition to glandular pads in 17/18 and 18/19, *V. tunnackensis* has markings pre-setal near the spermathecal pores in 7–9, and widely paired in ab in 19/20 and 20/21. This latter arrangement is not met in *V. borealis*, plus the anterior markings are often mid-ventral, and paired discs frequently border the pads in 17/18 and 18/19. For *V. tunnackensis*, Jamieson (1974, p. 253) states 'As in all Tasmanian species of the genus, the genital markings of this species are distinctive', by this criterion *V. borealis* is also distinct.

Superficial resemblance of this species to *Diporochaeta diadema* sp. nov., that consistently has greater than eight setae in posterior segments, is discussed under Remarks in that species' account.

ETYMOLOGY 'borealis' for its predominantly northern distribution within the State.

DISTRIBUTION AND HABITAT

Found at the northern end of Lake Pedder under litter and in loam under Ti-tree, and at Wynyard, north-west Tasmania. Additional specimens from north-west Tasmania have also been identified at Lake Rowallan, Mt Roland and Mole Creek (Blakemore, in prep.).

Vesiculodrilus ventralis sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3336 (H), Bonnet Bay, Lake Pedder, 431150 5248260, 310 m, 12.4.1996, R. J. Blakemore, M. Driessen and M. Anderson, under rocks on hillside above creek, (mature specimen, dissected and figured, fig. 3).

PARATYPES:

- 14:3337** (P1), same collection details as H, (mature specimen, dissected).
14:3464 (P2), Mt Cawthorne, Lake Pedder, 427897 5249337, 310 m, 12.4.1996, R. J. Blakemore, M. Driessen and M. Anderson, in sand and debris on beach, (mature posterior amputee, dissected).
14:3446 (P3), Maria Creek, Lake Pedder, 442000 5250600, 310 m, 11.4.1996, R. J. Blakemore, along creek in sand / roots, (ac clitellate mature, possibly an amputee as pygome setose, dissected).
14:3447 (P4), same details as P3, (immature that argees externally).
14:1858 (P5–6), Maydena, Mueller Road, site 3, 453200 5259800, 540 m, 12.10.1993, R. D. D'Orazio and D. E. Soccol, (mature posterior amputee and complete mature, both dissected, plus 2 unregistered tails).

SPECIMEN:

14:3362 (S1), Mt Solitary, Lake Pedder, 438800 5244500, 310 m, 11.4.1996, R. J. Blakemore, (damaged mature specimen that is possibly the same species, see Remarks below).

EXTERNAL FEATURES

Slender body, tapering to tail. Lengths mm: (H) 75, (P1) 50, (P3) 58, (P6) 40, (P4 immature, 30 mm). Width: c. 1.5 mm. Segments: (H) 116, (P1) 118, (P3) 90, (P4) 85, (P6) 113. Colour: anterior and dorsum dark brown, ventrum pale, clitellum buff. Prostomium: open epilobous. Clitellum: $\frac{1}{2}$ 13–16. Dorsal pores: from 2/3 (small), from 3/4 on larger. Setae: 8 in regular rows although dorsal setae migrate more dorsally in posterior. (Note: an odd supernumary seta occasionally found in the posterior of H, P6). Nephropores: in c lines. Spermathecal pores: 6/7/8/9 in setal a lines (not diverging). Female pores: paired on 14. Male pores: paired on small porophores in ab. Genital markings: mid-ventral, presetal discs in 7–9 (H, P5, P6) or 7 only (P1, S1), 8–9 (P2); or absent (P3); tumid pads in all specimens in aa in 17/18 and 18/19, in

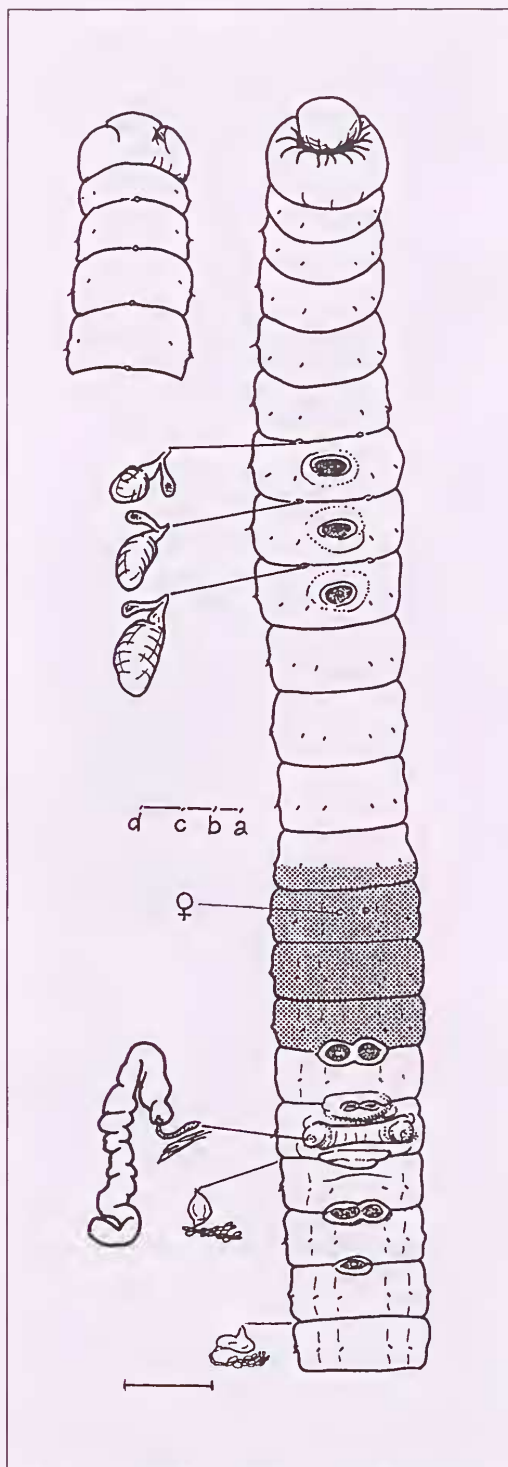


Figure 3. *Vesiculodrilus ventralis* sp. nov. Ventral view of (H) showing *in situ* spermathecae, nephridial bladders of 19lhs and 22lhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores.

(P1) there is an analogue of a disk wider than male pores in 17/18 on lhs; paired discs mid-ventral in aa in 16/17 (H, P3) and/or 19/20 (H, P3, P5, P6) and an analogue in 20/21 (in H only).

INTERNAL ANATOMY

Septa: none especially thickened. Gizzard: small and weakly muscular in 5. Oesophagus: pale and smooth walled (but not muscular) in 6 and 7; vascularised but only slightly dilated in 8–15; narrowing and valve-like in 16. Nephridia: vesiculate holoic in c lines; the bladders subspherical in the anterior but broadening after the clitellum; not tufted anteriorly. Vascularization: hearts in 10–12 from well developed supra-oesophageal vessel in 6, 7–13. Spermathecae: 3 pairs in 7–9, elongate ampulla distinct from short duct with simple diverticulum ectally. Male organs: holandric iridescent testes and funnels in 10 and 11 in mucus; seminal vesicles racemose in 9 and 12. Ovaries: compact in 13. Prostates: tubular in 18, throwing loop forward into 17 and extending to 20, 21; short penial setae present. Intestine: origin $\frac{1}{2}$ 17; no typhlosome but low dorsal ridge present (from about 26); gut contents, organic soil and grits.

REMARKS

Differences of *Vesiculodrilus ventralis* from *V. borealis* are an often darker colour, smaller gizzard, the greater extent of the tubular prostates and, especially, the differences in distribution of genital markings as described above and as shown in the respective illustrations. The spermathecal pores also tend to be closer to setal a lines. Paired, pre-setal markings in 7–9 are noted in some specimens, nevertheless, this species remains distinct from *V. tumackensis* for reasons similar to those given for *V. borealis*. Widely paired markings in 19/20–20/21 are lacking (this arrangement was found in the solitary Mt Solitary specimen that also had a mid-ventral pad in 7).

ETYMOLOGY 'ventralis' for the mid-ventral genital markings.

DISTRIBUTION AND HABITAT

Apparently widely distributed at the southern end of Lake Pedder under rocks and in sand / roots along creeks and shoreline, and at Maydena that is adjacent to the TWWHA.

Diporocheata diadema sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3495, (H) Coronets, Lake Pedder shoreline, 437900 5248800, 310 m, 11.4.1996, R. J. Blakemore and T. J. Kingston, in litter under eucalypts beside creek, (mature complete, dissected, figured, fig. 4a).

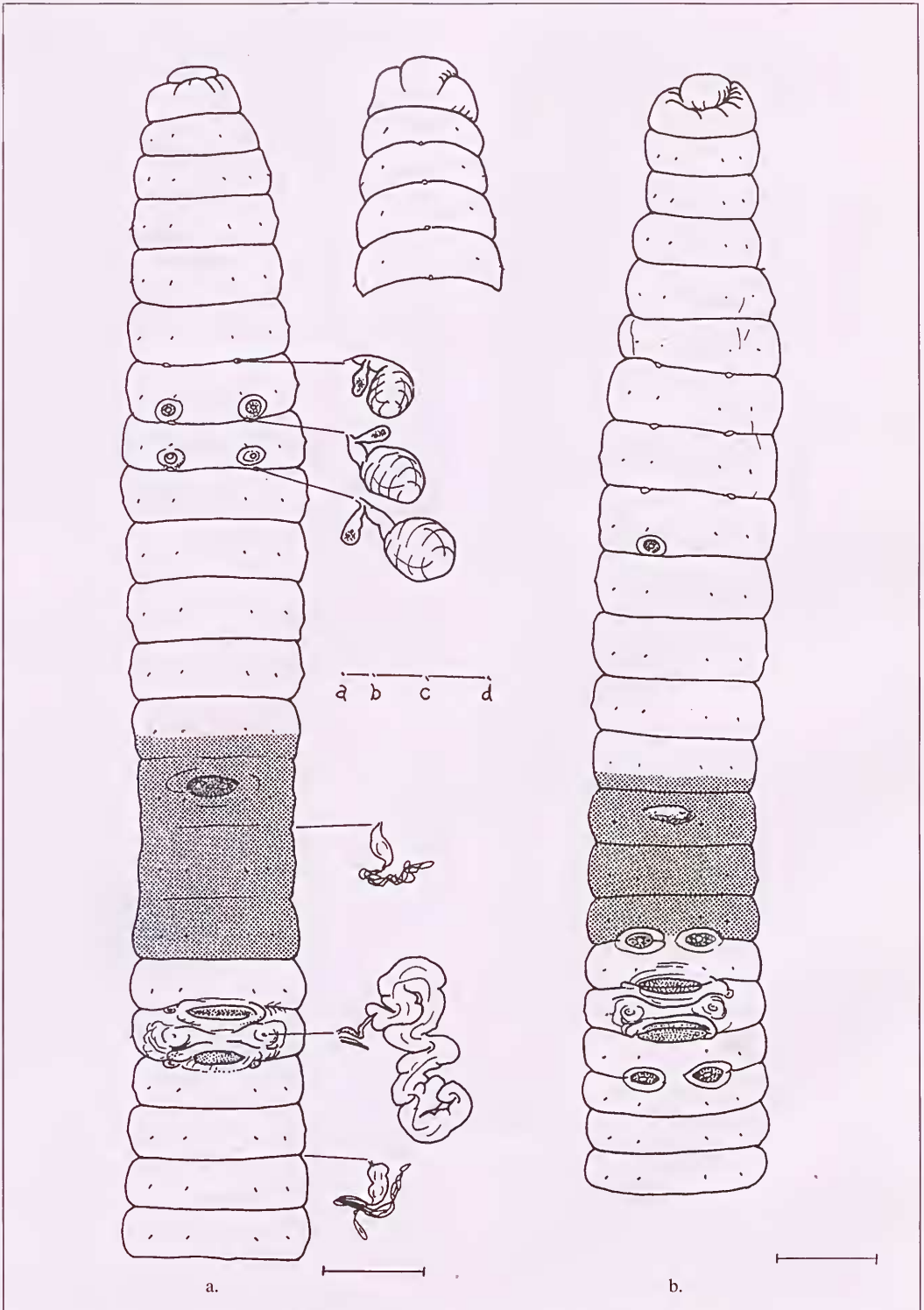


Figure 4. *Diporochaeta diadema* sp. nov. 4a. Ventral view of (H) showing *in situ* spermathecae, nephridial bladders of 15rhs and 21rhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores; 4b. Ventral view of (P1).

PARATYPES:

- 14:3496** (P1), same details as H, (mature posterior amputee, dissected and figured—fig. 4b).
14:3497 (P2), same details as H, (mature, posterior regenerate).
14:3498 (P3), same details as H, except under leaves on lake's edge, (mature, posterior amputee, dissected).
14:3462 (P4–11), same details as (P3), (8 specimens: 3 mature, posterior amputees, 5 immatures, one a posterior regenerate plus an unregistered tail).
14:3499 (P12–13), same details as (P3), (2 subadults, both complete).
14:3463 (P14–20), same details as (H), (7 specimens: a mature tail regenerate; 2 subadults, one a posterior amputee; a juvenile; and 3 immature posterior amputees).

EXTERNAL FEATURES

Body circular in section, tail blunt. Lengths mm: (H) 45, (P1) 40+, (P2) 30+, (P12) 45, (P13) 40, (P12–13) 45–40, (P14) 25+, (P15) 40, (immatures, c. 25–35 mm). Width: c. 1.5 mm. Segments: (H) 97, (P1) 99+, (P2) 85+ (posterior regenerate from 72), (P3) 54+, (P12–13) 100–104, (P14) 40+25 (regenerated), (P15) 108. Colour: anterior and dorsum light lilac–brown with darker mid-dorsal line, ventrum pale, clitellum buff. Prostomium: open epilobous. Clitellum: ½13–16. Dorsal pores: from 2/3. Setae: 8 in regular rows in the anterior; d line migrates more dorsally in the posterior and becomes sinuous and in the tail (i.e., from segment 50 (H), 85 (P1), 71 (P2), 72 (P12), 90 (P14), 80 (P15), and in all complete immatures) setae are added irregularly between c and d (and sometimes between a and b too) to give 10 or more setae per segment. Nephropores: in c lines in the anterior. Spermathecal pores: 6/7/8/9 just lateral of setal a lines (diverging slightly). Female pores: paired on 14. Male pores: paired on small porophores in ab. Genital markings: paired (sometimes analogue), postsetal discs in a lines in some of 7–9: in 7–9 (P4), 7–8 (H, P2), rhs 8 and lhs 9 (P14), 9 only (P13), lhs in 9 (P1, P15, P16), or absent (P3, P5, P12); mid-ventral elongate pads in aa in 17/18 and 18/19 (all specimens), rarely with terminal discs in ab (P14 only); sometimes paired eye-like discs in 16/17 (P1, P13) and/or 19/20 (P1, P6, P12, P13, P15, P16).

INTERNAL ANATOMY

Gizzard: flask-shaped in 5. Oesophagus: pale and smooth walled (but not muscular) in 6 and 7; increasingly vascularised and dilated in 8–15; narrowing and valve-like in 16. Nephridia: vesiculate holoic in c lines; the bladders elongate in the anterior, becoming bilobed after the clitellum; not tufted anteriorly. Vascularization: hearts in 10–12 from weak supra-oesophageal vessel in 9–12. Spermathecae: 3 pairs in 7–9, saccular ampulla on distinct duct with simple diverticulum ectally. Male organs: holandric iridescent testes and funnels in 10 and 11 in mucus; seminal vesicles racemose in 9 (small) and 12 (large). Ovaries: palmate in 13; small ovisacs sometimes

in 14. Prostates: tubular 17–20; fine penial setae present. Intestine: origin ½17; no typhlosole but a low dorsal ridge seen; gut contents organic sandy soil.

REMARKS

Diporochaeta diadema is similar to *Diporochaeta hellyeri* (Jamieson, 1974) and to *Diporochaeta montisarthuri* (Jamieson, 1974): all three species have three pairs of spermathecal pores and add setae posteriorly. However in the latter two species spermathecae are in b lines rather than in a lines and, moreover, the arrangements of genital markings differ. Many specimens of *D. diadema* are posterior amputees or regenerates, certainly some were damaged during collection, but perhaps this attribute is indicative of a susceptibility to predation or a propensity for autotomy.

Posterior amputees specimens of *Vesiculodrilus borealis* or *V. ventralis* may be confused with *D. diadema*, resolution may rest on the differences in genital markings (neither has paired post-setal markings in the anterior) and possibly on the shape of the post-clitellar nephridial bladders that tend to be ocarina-shaped in these two vesiculodrilids.

ETYMOLOGY 'diadem' for the 'Coronets' location.

DISTRIBUTION AND HABITAT

Apparently restricted: found only on shoreline under Coronet Range east of Lake Pedder, in litter.

Diporochaeta gordonii sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

- 14:3385** (H), laneway off Island Road, Lake Gordon south, 438800 5258900, 310 m, 14.4.1996, R. J. Blakemore, under myrtle / Huon pine forest litter and beside creek on shoreline, (a mature specimen, missing tip of tail, dissected and figured, fig. 5).

PARATYPES: all same details as (H):

- 14:3386** (P1), (a posterior amputee, dissected).
14:3387 (P2), (mature dissected).
14:3388 (P3), (mature, dissected).
14:3389 (P4), (mature, posterior amputee).
14:3390 (P5), (mature).
14:3391 (P6), (mature).
14:3392 (P7), (acitellate mature).
14:3393 (P8), (mature).
14:3394 (P9), (clitellate, posterior amputee).
14:3395 (P10), (acitellate mature).
14:3396 (P11), (acitellate mature).
14:3397 (P12–14), (an acitellate mature, posterior amputee plus 2 immatures plus several unregistered tail portions)

EXTERNAL FEATURES

Caudal regions, near where extra setae are added, often thin and pale (in complete, unregenerated, specimens). Lengths mm: (H) 70+, (P2) 75, (P3) 62, (P5) 45, (P6) 42. Width: c. 1.5 mm. Segments: (H) 108+, (P2) 123, (P3) 109, (P5) 100, (P6) 114. Colour: anterior and dorsum brown with darker mid-dorsal line, ventrum and posterior pale, clitellum buff. Prostomium: open epilobous. Clitellum: $\frac{1}{4}$ 13, $\frac{1}{2}$ 13–16. Dorsal pores: ($\frac{1}{2}$ non-functional?), functional from 2/3. Setae: 8 on 12 and 20 in regular rows; in caudal segments (i.e. from 98 in H, 75 in P2, 87 in P3, 89 in P6) suddenly (or gradually in P5 from segment 50) add setae between ab, bc or in and above cd to give 14–18 setae per segment. Nephropores: in c lines in anterior and in d or e in posterior. Spermathecal pores:

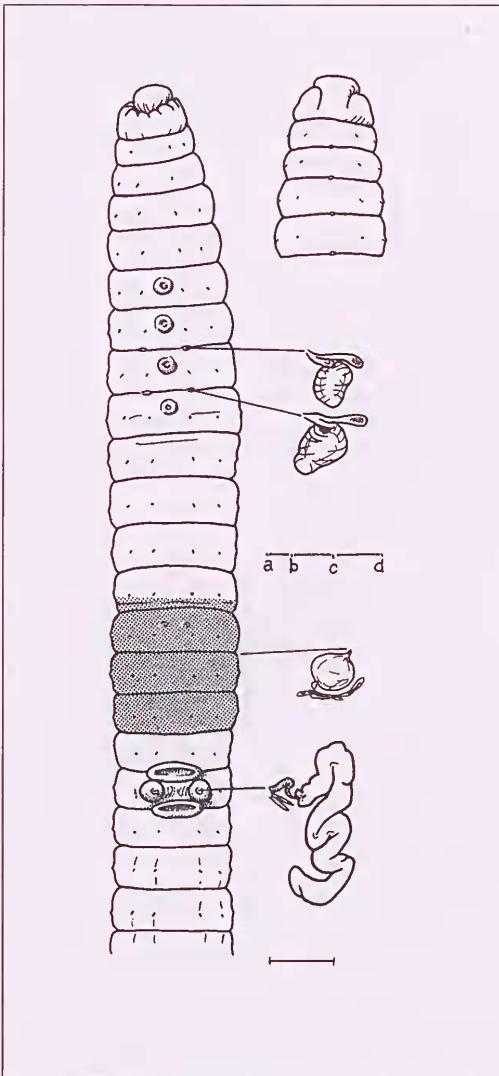


Figure 5. *Diporochaeta gordonii* sp. nov. Ventral view of (H) showing *in situ* spermathecae, nephridial bladder of 15rhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores.

7/8/9 just lateral of setal a lines. Female pores: paired on 14. Male pores: paired on small porophores in ab but nearer a line. Genital markings: weak presetal, mid-ventral discs in some or all of 6–9 (mostly in 7–9); in all specimens, elongate pads in aa in 17/18 and 18/19.

INTERNAL ANATOMY

Gizzard: muscular, flask or barrel-shaped in 5. Oesophagus: smooth and internally lamellate in 6– $\frac{1}{2}$ 7 but not muscular; thereafter vascularised to 15 or 16 where it narrows and becomes valvular with a thickened wall. Nephridia: vesiculate holoic in c lines in anterior; bladders spherical, large and flattened. Vascularization: hearts 10–12 from supra-oesophageal vessel in 8–13. Spermathecae: 2 pairs in 8 and 9, subspherical ampulla with medium sized diverticulum from duct. Male organs: holandric, iridescent testes and funnels in mucus in 10 and 11; seminal vesicles racemose in 9 and 12. Ovaries: branching in 13; ovisacs in 14. Prostates: tubular 18–20; short penial setae present. Intestine: origin $\frac{1}{2}$ 17; no typhlosole; gut contents mainly organic matter.

REMARKS

Apart from *Diporochaeta gordonii*, the only known Tasmanian species of the genus having 2 pairs of spermathecae is *Diporochaeta moroea* (Spencer, 1895). However, this latter species is larger with more setae in the anterior, has different genital markings, dorsal pores from 3/4, and, significantly, lacks nephridial bladders (pers. obs. from inspection of type specimen in Museum of Victoria, NMV: G292).

DISTRIBUTION AND HABITAT

Possibly restricted: Lake Gordon south, under myrtle beech *Nothofagus cuninghamii* / Huon pine *Lagarostrobos franklinii* litter on shoreline.

Diporochaeta lacustris sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3431 (H), Maria Creek, Lake Pedder west, 441700 5251000, 310m, 11.4.1996, R. J. Blakemore, in wet soil along creek, (a mature specimen, dissected and figured, fig. 6).

PARATYPES:

- 14:3442 (P1), same details as (H), (mature, posterior amputee, dissected).
 14:3443 (P2), Cripps Point, Lake Pedder east, 429000 5242900, 310 m, 12.4.1996, M. Anderson, under button grass near creek, (mature, posterior amputee, dissected).
 14:3444 (P3), same details as (P2), (mature, complete, dissected, plus 8 unregistered tails).
 14:3433 (P4–15), same details as (H), (12 specimens: 10 matures—three posterior amputees, and 2 subadults—one a posterior amputee).

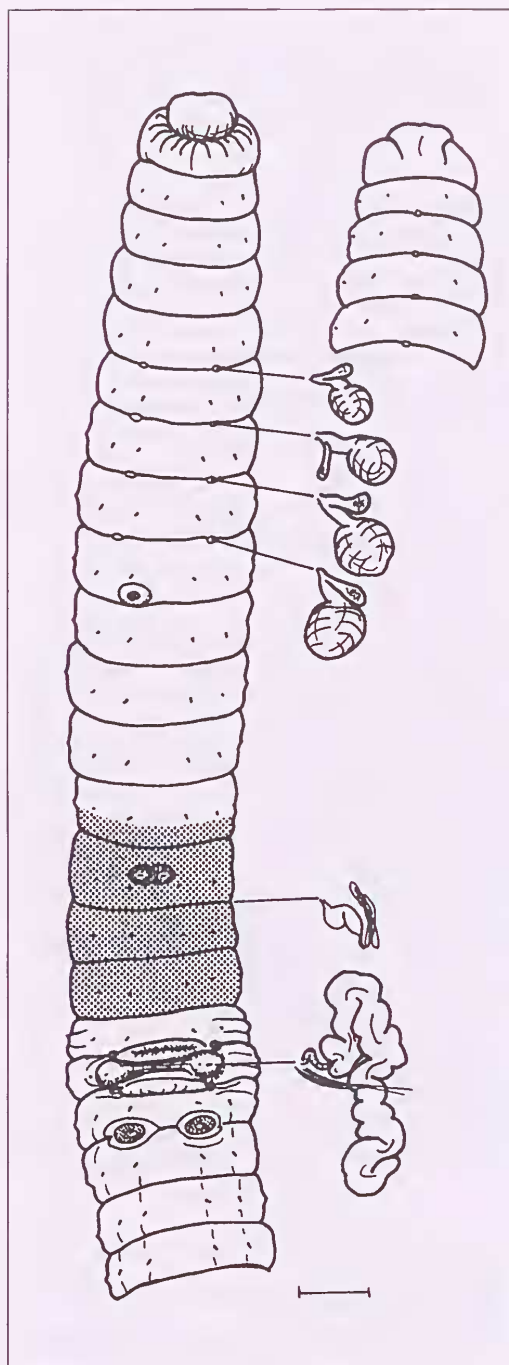


Figure 6. *Diporochaeta lacustris* sp. nov. Ventral view of (H) showing *in situ* spermathecae, nephridial bladder of 15rhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores.

14:3435 (P16–20), same details as (H), except in sand in creek bed, (5 complete matures and an unregistered tail).

EXTERNAL FEATURES

Lengths mm: (H) 110, (P1) 105, (P2) 75+, (P3) 80, (P4–9) 75–110, (P16–20) 65–90. Width: c. 2 mm. Segments: (H) 146, (P2) 78+, (P3) 137. Colour: anterior and dorsum puce with darker mid-dorsal line, ventrum yellow, tail pale, clitellum buff. Prostomium: open epilobous, faintly furrowed. Clitellum: ½13–16. Dorsal pores: from 2/3 (1/2 rudimentary—but see Remarks below). Setae: 8 anteriorly in regular rows (although d line moves more dorsally in posterior), increasing to 10–12 or more per segment in tail (e.g. from segment 96 in (H), 69 in (P2), 61 in (P3)). Nephropores: in c lines in anterior. Spermathecal pores: 5/6/7/8/9 just lateral of setal a lines (diverging slightly). Female pores: paired on 14. Male pores: paired on small porophores in ab (setae b, or follicles, retained). Genital markings: paired or analogue post-setal discs in a lines in 8 or 9 thus: 8 rhs (P2), 9 lhs (H, P19–20), 9 rhs (P10), or paired in 9 (P1, P5–6, P8, P14, P15), or absent (P3, P4, P7, P9, P11–13, P16–18); tumid pads in aa in 17/18 and 18/19 in all mature specimens; paired or analogue eye-like discs in a lines in 19/20 (in all specimens except P3).

INTERNAL ANATOMY

Gizzard: barrel-shaped, muscular in 5. Oesophagus: smooth and pale in 6 and 7, vascularised and increasingly dilated in 8–15, valvular in 16. Nephridia: vesiculate holoic in c lines; not tufted anteriorly, bladders bilobed or elongate. Vascularization: hearts in 10–12 from weak supra-oesophageal vessel in 8, 10–12, 13. Spermathecae: 4 pairs in 6–9, saccular ampulla distinct from short duct with simple diverticulum ectally. Male organs: holandric, iridescent funnels in mucus in 10 and 11; seminal vesicles racemose in 9 and 12. Ovaries: in 13; small pair of ovisacs in 14. Prostates: tubular 17–20.21; penial setae present. Intestine: origin 17; no typhlosole; gut contents colloidal soil.

REMARKS

Diporochaeta lacustris along with the newly described *D. rubertumula* and *D. setosa* are unique in the genus in Tasmania in having four pairs of spermathecae (these three species are separated mainly on the distributions of their genital markings and setal arrangements). *D. lacustris* differs from *D. rubertumula* by having genital markings that are widely paired or analogue in the anterior in 8 and / or 9 (where present) rather than mid-ventral, plus small penial setae; both differ from *D. setosa* in having only eight setae in the anterior. Nevertheless, all three species are morphologically similar to sympatric species which have only three pairs of spermathecae: *D. diadema* and *V. ventralis*, the latter differing generically in having plesiomorphic lumbricine state throughout.

Specimen P3 is interesting in that its colour and body shape (yellow with a dorsal gutter in the posterior half of the body) and its dorsal pores, which although present from 2/3 appear non-functional until 20/21 to about 50/51 (alcohol could be seen to extrude under slight pressure only in this latter range). In these respects, specimen P3 resembles *H. pedderensis*.

ETYMOLOGY 'lacustris' of the lake.

DISTRIBUTION AND HABITAT

Maria Creek on the west shore and Cripps Point on the east shore of southern Lake Pedder, mainly in wet sand along creeks and under button grass *Gymnoschaenus sphaerocephalus*.

Diporochaeta rubertumula sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3410 (H), Red Knoll Lookout, south Lake Pedder, 440600 5234600, 400m, 8.4.1996, T. J. Kingston, (a mature specimen, possibly a posterior amputee as the body appears truncated, dissected and figured, fig. 7).

PARATYPES: all with same collection details as (H):

14:3411 (P1), (mature, posterior amputee, dissected).

14:3412 (P2), (mature, the last 24 segments are abruptly pale and thinner, possibly a posterior regenerate although this may also be a normal characteristic).

14:3413 (P3), (mature, posterior amputee, dissected).

14:3414 (P4), (mature, posterior amputee).

14:3415 (P5), (mature, complete).

14:3416 (P6), (mature, acitellate).

14:3417 (P7), (acitellate, posterior amputee).

14:3418 (P8-9), (2 specimens both acitellate, posterior amputees, plus 14 unregistered tails and bits).

EXTERNAL FEATURES

Body tapering abruptly at tail which is often unpigmented (e.g. H, P2, P6). Lengths mm: (H) 65 (+7), (P2) 48, (P6) 50. Width: c. 2 mm. Segments: (H) 106, (P2) 93, (P6) 105. Colour: anterior and dorsum puce with darker mid-dorsal line, ventrum pale, clitellum buff. Prostomium: open epilobous. Clitellum: $\frac{1}{2}$ 13-16. Dorsal pores: from $\frac{2}{3}$ (1/2 rudimentary). Setae: 8 anteriorly in regular rows (although d line moves more dorsally in posterior), increasing to 10-12 or more per segment in tail (e.g. from segment 96 in (H), 70 in (P2), 80 in (P6)). Nephropores: in c lines in anterior. Spermathecal pores: 5/6/7/8/9 just lateral of setal a lines (not diverging). Female pores: paired on 14. Male pores: paired on small porophores in ab (setae b, or follicles, retained). Genital markings: single, mid-ventral post-setal discs in some or all of 6-9: in 6-9 (P1); 7-8 (H, P2, P4, P5, P7); or only in 7 (P8) or in 8 (P3); single mid-ventral pre-setal disc also in 8 or 9 (in H, P1, P2, P4, P5), or closely paired discs in 8 in aa (in P9 only), or absent (P6); tumid pads in aa in 17/18 and 18/19 in all mature specimens; eye-like discs in a lines in 19/20 (in H, P1, P3, P6-9) and sometimes an analogue in 20/21 (in H, P1).

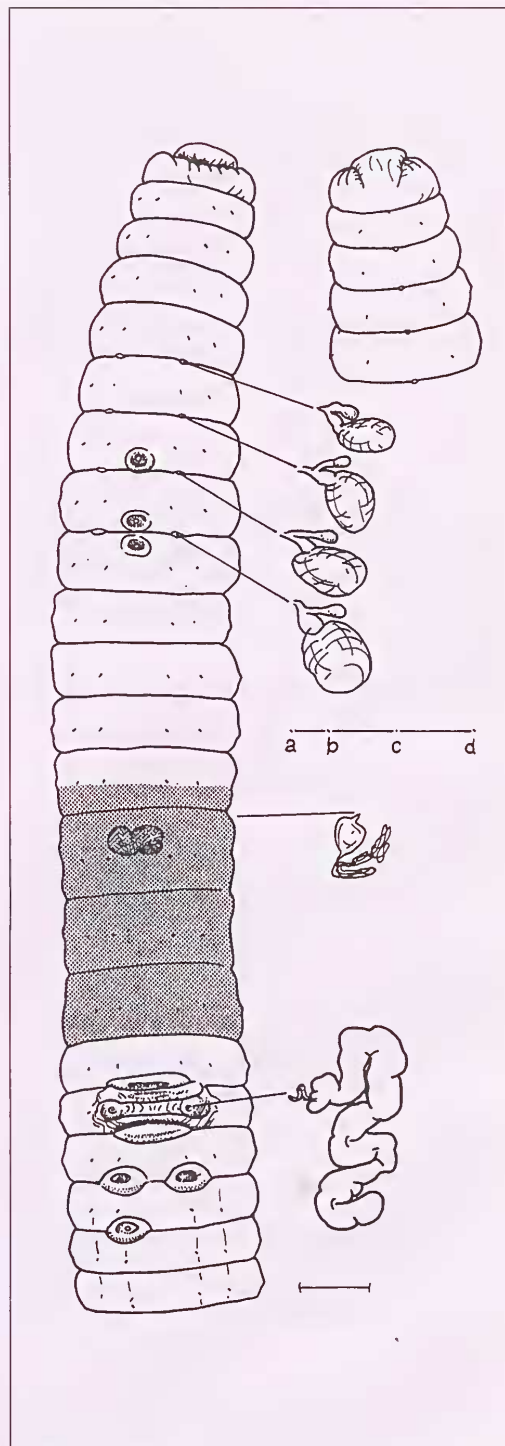


Figure 7. *Diporochaeta rubertumula* sp. nov. Ventral view of (H) showing *in situ* spermathecae, nephridial bladders of 14rhs, prostate ducting to male pore; plus view of prostomium showing dorsal pores.

INTERNAL ANATOMY

Septa: none especially thickened. Gizzard: flask-shaped, weakly muscular in 5. Oesophagus: smooth and pale in 6 and 7, vascularised and increasingly dilated in 8–15, valvular in 16. Nephridia: vesiculate holoic in c lines; not tufted anteriorly, bladders subspherical. Vascularization: hearts in 10–12 from supra-oesophageal vessel in 9–13. Spermathecae: 4 pairs in 6–9, saccular ampulla distinct from short duct with simple diverticulum ectally. Male organs: holandric, iridescent funnels in mucus in 10 and 11; seminal vesicles racemose in 9 and 12. Ovaries: in 13; small pair of ovisacs in 14. Prostates: tubular 17–20, 21; penial setae not found. Intestine: origin 17; no typhlosole but a low dorsal ridge from about 22; gut contents, organic soil.

ETYMOLOGY 'rubertumula' for the 'Red Knoll' location.

REMARKS

The main distinction of *D. rubertumula* from *D. lacustris* is in the distribution of genital markings, these being mid-ventral in the anterior rather than paired (or absent). Apparent lack of penial setae (in dissected specimens) is an additional distinction.

DISTRIBUTION AND HABITAT

Restricted: Red Knoll Lookout, southern Lake Pedder.

Diporochaeta setosa sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3382 (H), Stillwater under Hermit, Lake Pedder east, 428200 5258200, 310 m, 14.4.1996, R. J. Blakemore, in sandy soil on shoreline, (a mature specimen, dissected and figured, fig. 8).

PARATYPES:

14:3459 (P1), Mt Cawthorne, 427897 5249337, 310 m, 12.4.1996, R. J. Blakemore and M. Driessen, in beach sand and muddy soil, (mature, dissected).

14:3442 (P2), Cripps Point, 429000 5242900, 310 m, 12.4.1996, M. Anderson, under button grass near creek, (mature, posterior amputee, dissected and figured).

14:3422 (P3), Bell Basin, 419600 5259700, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, under button grass, (a single mature specimen in 2 halves).

14:3383 (P4), same details as (H), (mature specimen, damaged in anterior, dissected).

14:3460 (P5–6), same details as (P1), (2 mature posterior amputees, plus 2 unregistered tails).

14:3465 (P7), same details as (P1), (a mature posterior amputee).

14:3338 (P8), Bonnet Bay, 431150 5248260, 310 m, 12.4.1996, R. J. Blakemore, M. Driessen, M. Anderson, T. J. Kingston, under stones on hillside, (mature, dissected).

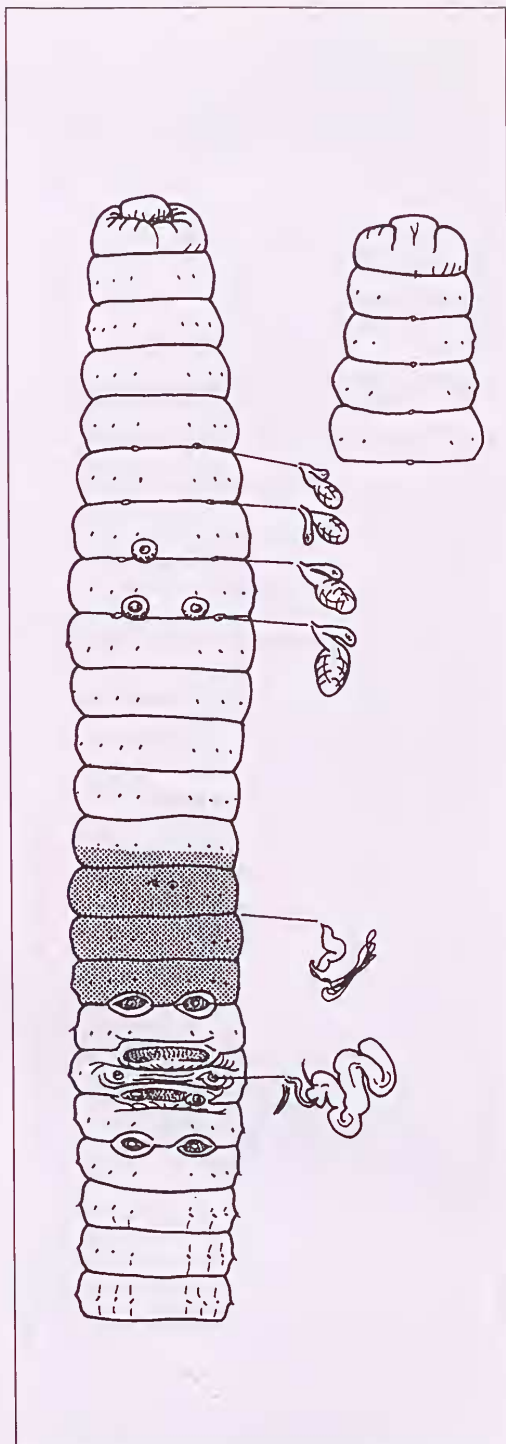


Figure 8. *Diporochaeta setosa* sp. nov. Ventral view of (H) showing *in situ* spermathecae, nephridial bladder of 15rhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores.

EXTERNAL FEATURES

Lengths mm: (H, P1) 65, (P3) 50, (P4) 63, (P8) 80. Width: c. 2 mm. Segments: (H) 116, (P1) 110, (P3) 121, (P4) 112, (P8) 92. Colour: anterior and dorsum dark brown, ventrum and tail pale, clitellum buff. Prostomium: open epilobous, faintly furrowed. Clitellum: $\frac{1}{2}$ 13–16. Dorsal pores: from 2/3 (1/2 rudimentary). Setae: 10 (P2, P8) or more often 12 throughout in regular rows, may add setae in tail (e.g. last 25 segments in P1). Nephropores: large in c lines (decastose specimens) or d lines (duodecastose specimens). Spermathecal pores: 5/6/7/8/9 diverging from just lateral of setal a lines in 5/6 to just median of b lines in 8/9. Female pores: paired on 14. Male pores: paired on small porophores in b. Genital markings: paired, or analogue, postsetal discs in (or median to) a lines in some or all of 6–9, or absent (from P3, P4, P6, P7); tumid pads in bb in 17/18 and 18/19 in all mature specimens (with a pair, or analogues, of discs in bc lines in 17/18 (P1, P3, P6, P8) and / or in a or b lines in 18/19 (H, P2, P3); paired eye-like discs in a line in 16/17 (H, P7, P8) and/or 19/20 (H, P2, P3, P7) or an analogue (P4, P5, P8).

INTERNAL ANATOMY

Gizzard: small, barrel-shaped in 5. Oesophagus: smooth and pale in 6 and 7 (internally lamellate but not muscular), vascularised 8–15, valvular in 15, 16. Nephridia: vesiculate holoic in d lines; not tufted anteriorly, bladders round, clongate, bilobed or ocarina-shaped. Vascularization: hearts in 10–12 from weak supra-oesophageal vessel in $\frac{1}{2}$ 7–13. Spermathecae: 4 pairs in 6–9, saccular ampulla tapering to short duct with simple diverticulum ectally. Male organs: holandric, iridescent funnels in mucus in 10 and 11; seminal vesicles large, racemose in 9 and 12. Ovaries: large in 13; small pair of ovisacs in 14. Prostates: tubular 17, 18–19, 20, 21; small penial setae present. Intestine: origin 17, $\frac{1}{2}$ 17; no typhlosole (may have low dorsal ridge); gut contents, organic, gritty soil.

REMARKS

Diporochoeta setosa differs from *D. rubertumula* and *D. lacustris* primarily in having 10–12 setae in the anterior (rather than 8), secondly in the diverging spermathecal pores, and thirdly in the variation of its genital markings. Specimens having 12 setae are superficially reminiscent of *H. pedderensis*, but differ in their lack of multiple oesophageal gizzards, and in having tubular prostates and dorsal pores in the anterior.

ETYMOLOGY 'setosa' having (more) setae.

DISTRIBUTION AND HABITAT

Widely distributed around Lake Pedder shorelines, in beach sand or along creeks and under button grass *Gymnoschaenus sphaerocephalus* or rocks.

Perionychella dilwynnia (Spencer, 1895) comb. nov.

Perichaeta dilwynnia Spencer, 1895, pp. 50–51, figs 46–48

Diporochoeta dilwynnia; Michaelsen, 1900, p. 204

Perionychella (*Vesiculodrilus*) *dilwynnia*; Jamieson, 1974, pp. 234–36, figs 8B (p. 232), 16J (p. 256), plates 94–96

MATERIAL EXAMINED

TYPE MATERIAL:

Not present in NMV, presumed lost (Jensz & Smith, 1969). (Note: a neotype is not designated as this material is not from the Dee Bridge type-locality).

SPECIMENS:

- 14:3335** (S1), Bell Basin, Lake Pedder north, 310 m, 28.3.1996, A. Osborne and N. Forteath, (a mature specimen, dissected and figured, fig. 9).
14:3469 (S2), Sprent Basin, Lake Pedder north, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, under Ti-tree on edge of lake, (a mature, posterior amputee, dissected).
14:3470 (S3), same details as (S1), (an acitellate mature). TM:K 266–274, BM:1972:8:4–7, Tarraleah, central Tasmania, 146°25'E 42°20'S, 27.5.1954, J. L. Hickman, over pipeline, (twelve mature specimens and a tail portion).

EXTERNAL FEATURES

Anterior paddle-shaped, body tapers to a flattened tail. Lengths mm: (S1) 62, (S3) 45, cf. 50 (Spencer), other specimens 50–70 mm. Width: 2.5–3.0 mm. Segments: (S1) 120, (S3) 113, other specimens 104–118. Colour: anterior gunmetal grey, dorsum brown, ventrum yellow, clitellum buff. Prostomium: epilobous, almost tanylobous, faintly furrowed; some specimens have ventral cleft. Clitellum: $\frac{1}{2}$ 13– $\frac{1}{2}$ 17. Dorsal pores: from 4/5. Setae: 14–16 on 12 almost evenly spaced, rows regular to midbody then become intercalated, increasing to 24–30 in posterior third of body where the dorsal most setae move more dorsally. Nephropores: lateral (in d or e lines). Spermathecal pores: 4/5–8/9 in mid-ab lines. Female pores: paired on 14. Male pores: paired on low mounds on 18 in ab. Genital markings: unpaired, mid-ventral discs, in posterior of some segments in 6–8; an elongate pad in aa anteriorly on 18; paired eye-like markings in a or ab lines in (18/19?), 19/20 and 20/21.

INTERNAL ANATOMY

Gizzard: slender, muscular in 5. Oesophagus: increasingly dilated in 6–14, 15, but not calciferous; contracted with thicker wall in 15 and / or 16. Nephridia: vesiculate holoic in c lines, the ducts translucent but only slightly dilated as elongate bladders exiting approximately in e lines; not tufted anteriorly. Vascularization: hearts in 10–12 with connectives to well

developed supra-oesophageal vessel in 7, 8–12, 13. Spermathecae: 5 pairs in 5–9, ampullae taper to ducts each with a simple diverticulum ectally. Male organs: holandric, testes and funnels in 10 and 11; seminal vesicles racemose in 9 and 12. Ovaries: palmate with many large egg strings in 13; ovisacs not found. Prostates: tubuloracemose reflexed in 17, 18–20; small penial setae present. Intestine: origin 17; no typhlosole to c. 45; gut contents, organic remains.

REMARKS

These small specimens agree tolerably with Spencer's original account, differences are that the prostomium extends for more than half of the first segment, small genital markings occur mid-ventrally in the anterior and the posterior markings are in 19/20 and 20/21 (not 18/19 and 19/20 as stated by Spencer). Also, seminal vesicles were found in 9 as well as 12, the usual holandric locations. Spencer (1895, p. 51) describes the prostates as 'wide, tubular with racemose surfaces extending through segments 17–20' while Jamieson (1974, p. 234) has them as 'depressed, lobulated tubular, with compressed coils in XVII–XX', i.e. tubuloracemose, thereby qualifying inclusion in *Perionychella*.

Distinctive characters of *Perionychella dilwynnia* are the 5 pairs of spermathecal pores in ab, numerous setae, tubuloracemose prostates and a genital pad preceding the male pores (which possibly corresponds with the anterior sucker-like markings in concopulants). The ventrally cleft peristomium in the Tarraleah specimens (described but not illustrated in Jamieson, 1974, fig. 8B) was not reported by Spencer, neither was it seen in the Lake Pedder specimens. Spencer described his species as 'meganephric' (i.e. holoic) but did not mention presence or absence of bladders. Spencer's figure 45 has the female pores closer than his description: 'just ventral of and anterior to, the innermost setae' (as in the specimens here). Jamieson's specimens (as here) had wide female pores and genital markings in 19/20 and 20/21; two of Jamieson's specimens also had seminal vesicles in 9, ovisacs in 14, and slender penial setae. Other differences between the present account and Jamieson's account are the gizzard is not 'almost rudimentary', the nephridial bladders are not 'long, wide, tortuous tubular'.

In *Perionychella*, a similar species is *P. hickmani* (Jamieson, 1974) that apparently differs in having spermathecal pores closer to, or in, setal a lines (Jamieson, 1974, fig. 6B) and in its lack of both the mid-ventral pad in 18 and genital markings in the anterior. While the nephridia were described (Jamieson, 1974, p. 227) with 'ducts tubular' these were presumably not classed as bladders as in *P. dilwynnia*.

DISTRIBUTION AND HABITAT

Widespread in central to south-western Tasmania: Dee Bridge (Spencer), around Tarraleah (Hickman / Jamieson), and, now, Lake Pedder where it was found under Ti-tree *Leptospermum* spp. litter in woodland on the lake's edge.

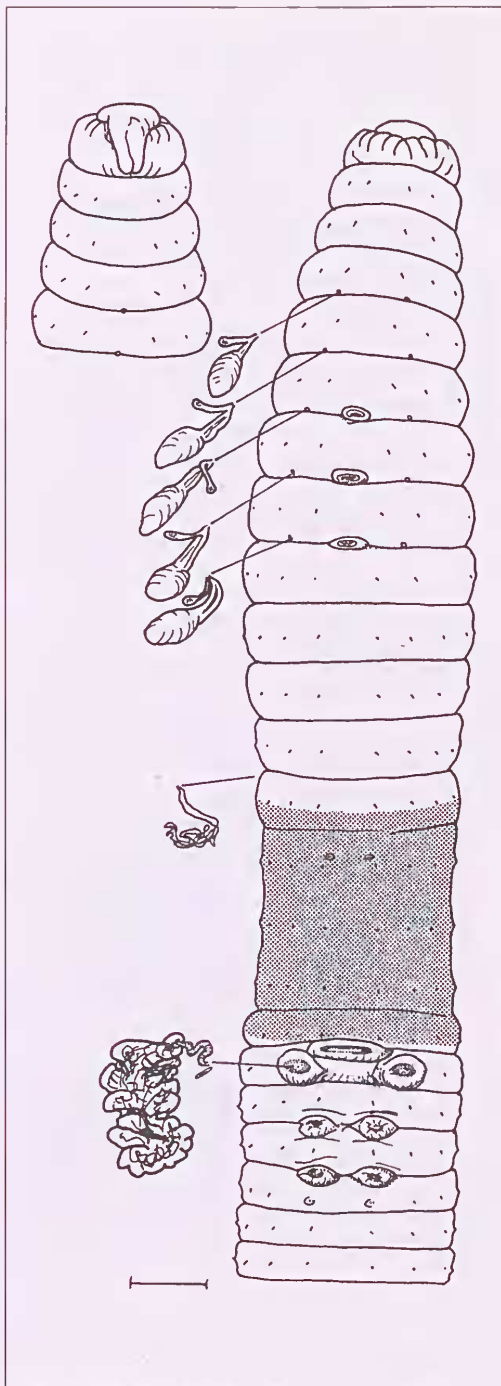


Figure 9. *Perionychella dilwynnia* (Spencer, 1895). Ventral view of 14:3335 showing *in situ* spermathecae, nephridial bladder of 13lhs, prostate ducting to male pore with penial setae; plus view of prostomium showing dorsal pores.

Perionychella variegata sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3340 (H), Sprent Basin, north Lake Pedder, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore, in loam in Banksia / Ti-tree scrub on edge of lake, (a mature specimen, dissected and figured, fig. 10).

PARATYPE:

14:3341 (P1), same details as H (a posterior amputee, dissected).

14:3485 same details as H (an immature, agreeing superficially).

EXTERNAL FEATURES

Length mm: (H) 115. Width: c. 5 mm. Segments: (H) 120. Colour: anterior and dorsum iridescent dark brown to flanks, ventrum yellow, clitellum brick-red (not ventrally). Prostomium: open epilobous, faint dorsal furrow. Clitellum: 13, 14–17 (saddle-shaped, not pronounced). Dorsal pores: (rudimentary in 2/3) small in 3/4, more distinct from 4/5. Setae: longitudinal series not quite regular, 32–40 in anterior increasing up to c. 42 in posterior, dorsal gap less than ventral gap. Nephropores: lateral in h–j, k or f–g lines. Spermathecal pores: 7/8/9 between c or d lines. Female pores: minute, paired on 14 antero-medial to a setae (one pore slightly off-centre in H). Male pores: paired on low mounds in c (no setae between male pores, follicles possibly retained). Genital markings: paired just ventral of spermathecal pores posteriorly in 8; paired in b lines in 19/20.

INTERNAL ANATOMY

Specimens infested with monocyctis. Gizzard: large and muscular in 5 but occupying 7–8. Oesophagus: dilated in 9–15, not calciferous. Nephridia: avascular holoic; not tufted anteriorly. Vascularization: dorsal blood vessel single, hearts in 10–12 from supra-oesophageal vessel in 9–12. Spermathecae: 2 pairs in 8 and 9, subspherical ampulla on short duct with simple diverticulum ectally. Male organs: holandric, iridescent testes and funnels in mucus in 10 and 11; seminal vesicles racemose small in posterior of 9 and 10 and anterior of 11 and 12 (i.e. 4 pairs). Ovaries: palmate in 13; no ovisacs. Prostates: flat, tubuloracemose 17–20, 22; penial setae not found. Intestine: origin 17; no typhlosole; gut contents, woody material.

REMARKS

Under the scheme of Jamieson (1974), this species would key out as *Perionychella capensis*, that has recently been shown (Blakemore, 1998) to belong to the genus *Retrovescus*. *Perionychella variegata* is morphologically similar to *P. irregularis* (Spencer, 1895) and both are sympatric at Pelion Valley (pers. obs.). The major differences in *P. variegata* are 2 rather than 3 pairs of spermathecae, and genital markings in 19/20 rather than 19/20/21.

ETYMOLOGY 'variegata' for its variegated colouration.

DISTRIBUTION AND HABITAT

Widespread: Lake Pedder in loam under Banksia / Ti-tree, and Pelion Valley (Blakemore, in prep.).

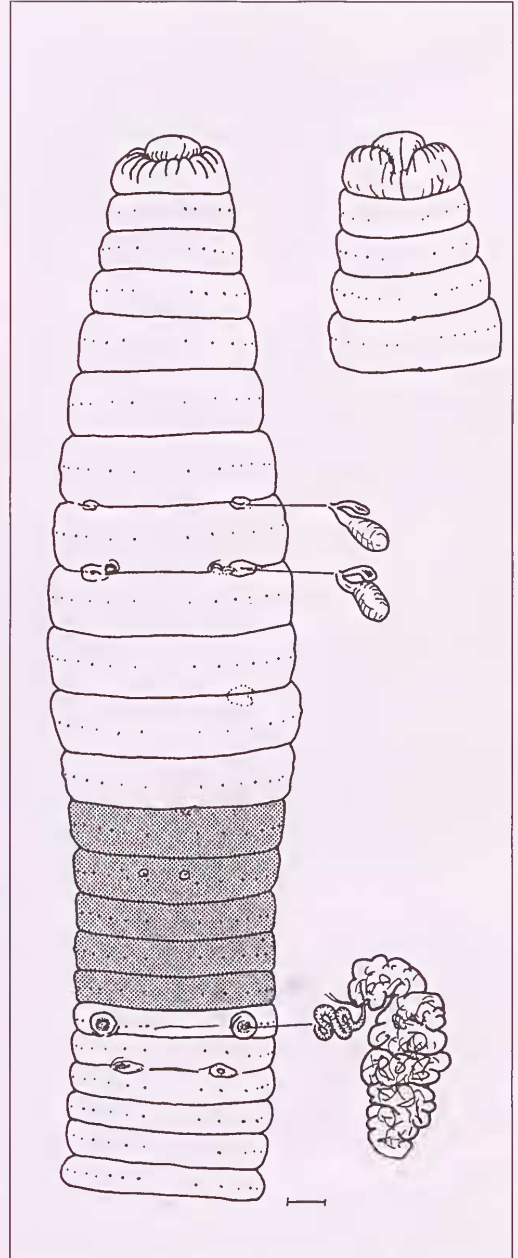


Figure 10. *Perionychella variegata* sp. nov. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore; plus view of prostomium showing dorsal pores.

Hypolimnus pedderensis (Jamieson, 1974)

gen. et. comb. nov.

Perionychella (*Vesiculodrilus*) *pedderensis* Jamieson, 1974, p. 251, figs 12C (p. 244), 16W (p. 256)

MATERIAL EXAMINED

HOLOTYPE:

TM:K311 (H), Lake Pedder, 14°61'2"E 42°57'S, 25.2.1971, P. Tyler. Labelled thus: 'Collected by Dr Peter Tyler on main beach of Lake Pedder, near where Maria Creek came to the lake. Dr P. Tyler pers. comm. 15.2.1991, R. H. Green'—'sorted from interstitial fauna' (a complete mature specimen, coiled and slightly damaged, previously dissected in the anterior only; refigured, fig. 11).

EXTERNAL FEATURES

Body tapering to tail, coiled with broad dorsal gutter in hindbody (possibly due to emaciation or preservation). Length mm: 50. Width: 1.5 mm. Segments: 129. Colour: anterior and dorsum faint brown pigmentation, yellowed in alcohol, clitellum buff. Prostomium: open epilobous (previously sectioned so furrowing not discernible). Clitellum: ½13–17 (damaged on lhs in 16). Dorsal pores: absent from anterior, present in midbody from 39/40 for about 35 segments (detected by mucal ejecta). Setae: 10 on 12 increasing to 24 in posterior with one or two extra setae caudally to give up to 28 per segment, in mostly regular series. Nephropores: lateral in straight series in c lines in anterior and d lines in posterior. Spermathecal pores: 5/6/7/8/9, diverging from just lateral of a lines, to mid-ab, to just median of b lines. Female pores: paired on 14. Male pores: paired on slight mounds in mid-ab lines (a penial seta protrudes, setae b retained). Genital markings: small, paired markings just antero-median of spermathecal pores in 8; elongate pads in 17/18 and 18/19 as wide as male pores, extending to mid-ab; paired eye-like markings in ab in 19/20 and a lhs analogue in 20/21.

INTERNAL ANATOMY

Septa delicate except for 11/12/13. Gizzards: muscular in 5, 6 and part of 7 (i.e. 2½ segments), smooth with muscular sheen externally, an anterior rim in 5 and a larger posterior rim in 6 that continues into 7, waisted at 5/6; previously sectioned and showing muscular body wall and deep longitudinal striae internally. Oesophagus: dilated in 8–13 but not calciferous, narrow in 14–16. Nephridia: vesiculate holocoe with small, thickened, spherical bladders apparent only from segment 5; not tufted anteriorly, nephridia reduced in size before segment 12. Vascularization: dorsal blood vessel single, widened on intestine; hearts 10–12, supra-oesophageal vessel developed in 8–13. Spermathecae: 4 pairs in 6–9, subspherical or heart-shaped ampulla on short duct with simple (or 8 lhs slightly bifid) diverticulum ectally (rhs 8 and 9 had been removed and were loose in body cavity). Male organs: holandric, iridescent testes and funnels in

mucus in 10 and 11; seminal vesicles racemose in 9 and, larger, in 12. Ovaries: palmate in 13; large paired ovisacs present on anterior septum in 14. Prostates: tubuloracemose 18–19, 20, surface slightly lobular with a weak central canal on section; penial setae seen externally but not found internally (partially removed?). Intestine: origin 17; no typhlosome but a low dorsal ridge present; gut void (elutriated?) except for mucus and several large quartzite grains (some of 0.8 mm diameter).

REMARKS

The present description of the holotype considerably augments the original account. Characters differing from the type description, or recorded for the first time, are:

- (1) Gizzards in 5–½7 (rather than 'Gizzard moderate, in VI').
- (2) Dorsal pores present, but confined to the mid-body (rather than 'absent').
- (3) Nephropores lateral in c-d lines (rather than '?').
- (4) Clitellum ½13–16 (rather than 'XIII–XVI' and as in Jamieson, 1974, fig. 12C).
- (5) Nephridia reduced before segment 12 (rather than 'appearing rudimentary to VII').
- (6) Prostates tubuloracemose (rather than 'thickly tubular').
- (7) Presence of a supra-oesophageal (rather than 'Suboesophageal') vessel.
- (8) Divergence of spermathecal pores to just median to b in 8/9 (cf. figs).
- (9) Correct locations of spermathecal pores and setae (cf fig. 11, Jamieson, 1974, fig. 12C).
- (10) Absence of rhs genital marking in a line in 20/21 (described but not shown in Jamieson, 1974, fig. 12C).

Referring to the generic diagnoses at the start of this paper, and according to Jamieson's description, this species would have been permissible in *Diporochaeta* rather than *Perionychella* for which it would qualify on the basis of its tubuloracemose prostates. However, multiple oesophageal gizzards (and reduced dorsal pores) warrant its placement in a new genus. Doubled (or tripled) oesophageal gizzards are a characteristic of several mainland genera (e.g. *Digaster*, *Perrisogaster*, *Didymogaster*), but these genera are lumbricine and meroic. *Hypolimnus* is the only perichaetine and holonephric genus known to have multiple oesophageal gizzards, and *H. pedderensis* the only species.

Hypolimnus pedderensis is morphologically close to several sympatric species (perhaps indicating a common ancestry), most notably those having some modification of the oesophagus in segments 6 and 7, i.e. *Vesiculodrilus ventralis*, *Diporochaeta diadema*, *D. gordonii* and *D. rubertumula*, *D. lacustris* and *D. setosa*. As previously noted, one specimen of *D. lacustris* was found to have most of its dorsal pores occluded. This raises the question whether the single specimen of *H. pedderensis* is an aberrant individual with regard to its dorsal pores.

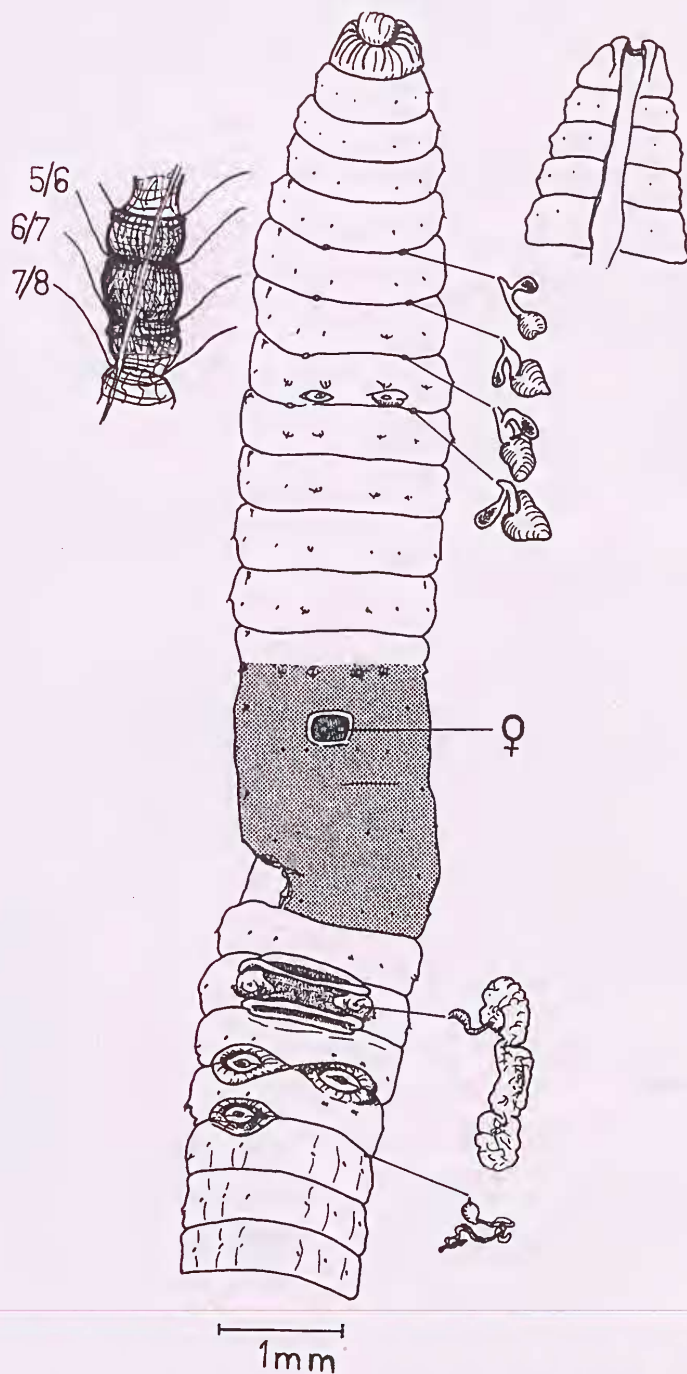


Figure 11. *Hypolimnus pedderensis* (Jamieson, 1974) gen. et. comb. nov. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore, nephridial bladder of 21rhs; plus *in situ* dorsal views of (bisected) gizzards in 5– $\frac{1}{2}$ 7, and (bisected) prostomium.

Unfortunately, this will probably remain the subject of speculation as an intensive survey of the new shoreline of Lake Pedder, including recently formed beaches in the region of Maria Creek, failed to locate any specimens corresponding with *H. pedderensis*, even allowing for the errors of the original account.

Furthermore, no additional material remained in the sample in which *H. pedderensis* was originally contained, apart from several immature tubificids (obtained from Queensland University and newly registered as QVM14:3476, labelled 'Lake Pedder, S.E. Tasmania, 15.2.1971, P. A. Tyler from interstitial fauna', and a Zoology Dept. Univ. of Qld. label [in Jamieson's hand?]: 'Loc. 45-Enchytraeids' (22 specimens, shrivelled and brittle, apparently immatures)).

DISTRIBUTION AND HABITAT

Known only from a single specimen collected from the original (now submerged) beach of east Lake Pedder, interstitial (in sand). Likely to be extinct.

Notoscolex dinephrus sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3352 (H), Sprent Basin, Lake Pedder north, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore, Banksia / Ti-tree on edge of lake, (a mature specimen, dissected and figured, fig. 12).

PARATYPES:

14:3481 (P1), same details as (H), (a subadult, dissected).

14:3482 (P2), same details as (H), (an acilicellate posterior amputee).

14:3490 (P3), Bell Basin, Lake Pedder north, 419600 5259700, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, under Ti-tree, (a mature specimen, complete but damaged in the midbody).

EXTERNAL FEATURES

Lengths mm: (H) 45, (P1) 30, (P3) 45. Width: c. 2 mm. Segments: (H) 116, (P1) 107. Colour: anterior delicate lilac, clitellum buff, remainder yellow. Prostomium: open epilobous. Clitellum: 1/3-17. Dorsal pores: from 5/6. Setae: 8 in regular rows. Nephropores: in a and d lines. Spermathecal pores: 7/8/9 in setal a lines. Female pores: paired on 14. Male pores: paired on small, conjoined porophores in ab, long penial setae protrude. Genital markings: (in all specimens) mid-ventral, presetal discs in 9 and 10, conjoined paired discs in ab lines in 17/18; (in H, P2 and P3) small, paired markings in a lines in 19/20.

INTERNAL ANATOMY

Gizzard: compact, muscular in 5. Oesophagus: dilated and internally lamellar in 13-15, larger in 14 perhaps forming calciferous gland. Nephridia: avesiculate meroic 2 sets of tubules per side in a and c lines, after the clitellum these become intertwined and appear holoic but presence of separate ducts in c and a lines reveal nature; funnels not found. Vascularization: hearts in 10-12 from supra-oesophageal vessel in 6, 7-12. Spermathecae: 2

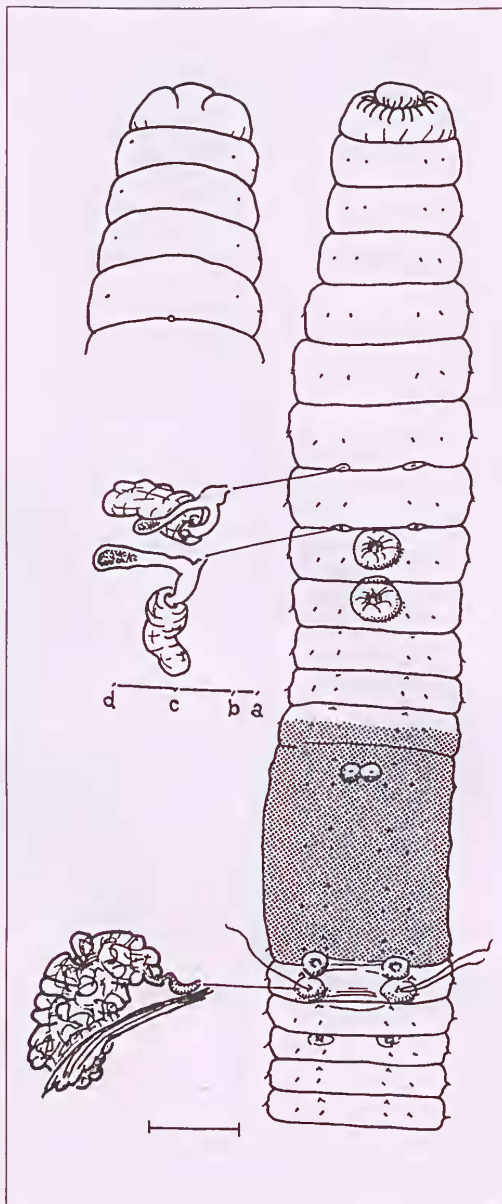


Figure 12. *Notoscolex dinephrus* sp. nov. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore with long penial setae; plus view of prostomium showing first dorsal pore.

pairs in 8 and 9, elongate ampulla distinct from duct, long diverticulum ectally. Male organs: holandric iridescent testes and funnels in 10 and 11; seminal vesicles small, racemose in 9 and larger in 12. Ovaries: palmate in 13. Prostates: tubuloracemose (or racemose?) 18–22; long penial setae present. Intestine: origin 17, deflecting septum 16/17 forwards; no typhlosole; gut contents woody organic matter and quartz grits.

REMARKS

Notoscolex dinephrus is morphologically similar to *N. pilus* Blakemore, 1997a, agreeing on almost each character. It is separated on the basis of its distinctive mid-ventral genital markings in 9 and 10 (seen in all specimens).

ETYMOLOGY 'dinephrus' for the nephridia reduced to two per side.

DISTRIBUTION AND HABITAT

Possibly restricted: north Lake Pedder in organic soil under *Banksia* and Ti-tree *Leptospermum* spp. scrub.

Aporodrilus dombrovskisi gen. et. sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3351 (H), Sprent Basin, Lake Pedder north, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore, in Ti-tree litter on edge of lake, (a mature specimen, dissected and figured, fig. 13).

PARATYPES:

- 14:3406** (P1), same details as (H), (mature, dissected).
14:3424 (P2), same details as (H), (mature posterior amputee, dissected).
14:3425 (P3), Scott's Peak, Huon Campsite, Lake Pedder south, 443200 5234500, 320 m, 8.4.1996, T. J. Kingston, in peaty layer over clay in rainforest, (mature, dissected).
14:3426 (P4), same details as (P3), (mature, posterior amputee).
14:3427 (P5–P6), same details as (P3), (2 immatures, one dissected).
14:3440 (P7), Maria Creek, Lake Pedder, 442300 5250500, 315 m, 11.4.1996, R. J. Blakemore, in Smithton peppermint *Eucalyptus nitida* woodland litter, (a mature anterior amputee plus an unregistered tail).
14:3483 (P8–9), Bell Basin, Lake Pedder north, 419600 5259700, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, in Ti-tree litter, (2 mature specimens).

EXTERNAL FEATURES

Lengths mm: (H) 120, (P1) 110, (P3) 100, (P8–9) c. 73, (P5–P6 immatures) c. 65. Width: c. 4.5 mm. Segments: (H) 128, (P1) 143, (P3) 133. Colour: light brown dorsum to lateral c lines anteriorly but recedes to faintly pigmented spine in dd posteriorly; ventrum pale; clitellum buff. Prostomium: open or closed epilobous, sometimes appearing almost tanylobous. Clitellum: 13, ½13, 14–½17, 17, saddle-shaped (only weakly developed ventrally in aa). Dorsal pores: absent. Setae: 8 in regular rows, ab (or at least their pores) retained on 18. Nephropores: not seen. Spermathecal pores: 7/8/9 in setal b lines. Female pores: paired on 14. Male pores: paired just lateral to b setae which are retained. Genital markings: nine or ten pairs of small discs in 9/10, 10/11–18/19, in line with spermathecal pores but converging to setal a lines in 14/15 or 15/16 then diverging; usually with pairs of larger pads in a lines in 19/20 and, often in 20/21 and 21/22 also, but here more convergent.

INTERNAL ANATOMY

Gizzard: large, flask-shaped in 5 displaced to occupy 7–8. Oesophagus: vascularized in 12–13, not calciferous. Nephridia: avesciculate meroic; larger but not tufted anteriorly; approximately three to five, or more, clusters of tubules per side, equatorial but associated with anterior septa; none especially enlarged; funnels not found. Vascularization: hearts in (9?) 10–12; supra-oesophageal vessel in 8–13. Spermathecae: 2 pairs in 8 and 9, ampulla ovoid with a thick, iridescent diverticulum preceded by a distinctive ectal diverticula appendage of unknown function. Male organs: holandric iridescent testes and funnels in 10 and 11 in mucus; seminal vesicles racemose in 9 and 12. Ovaries: palmate in 13, no ovisacs seen. Prostates: flattened, tubuloracemose 17–23, 24; enlarged penial setae absent. Intestine: origin 16; no typhlosole to 35; gut contents, organic soil and woody material; no intestinal gizzards.

REMARKS

Aporodrilus dombrovskisi is designated the type species of the genus for notoscolecine species that lack dorsal pores (and have intestinal origin in 16). Distinctive characters of *Aporodrilus dombrovskisi*, compared to other members of the genus, are the linear arrangement of genital markings, the unusual spermathecal appendages, and the retention of setae ab on 18 ventral to the male pores.

ETYMOLOGY in tribute to Peter Dombrovskis, photographer of the wilderness.

DISTRIBUTION AND HABITAT

Known only from Lake Pedder, but widespread around the shoreline, mainly in woodland litter or loam.

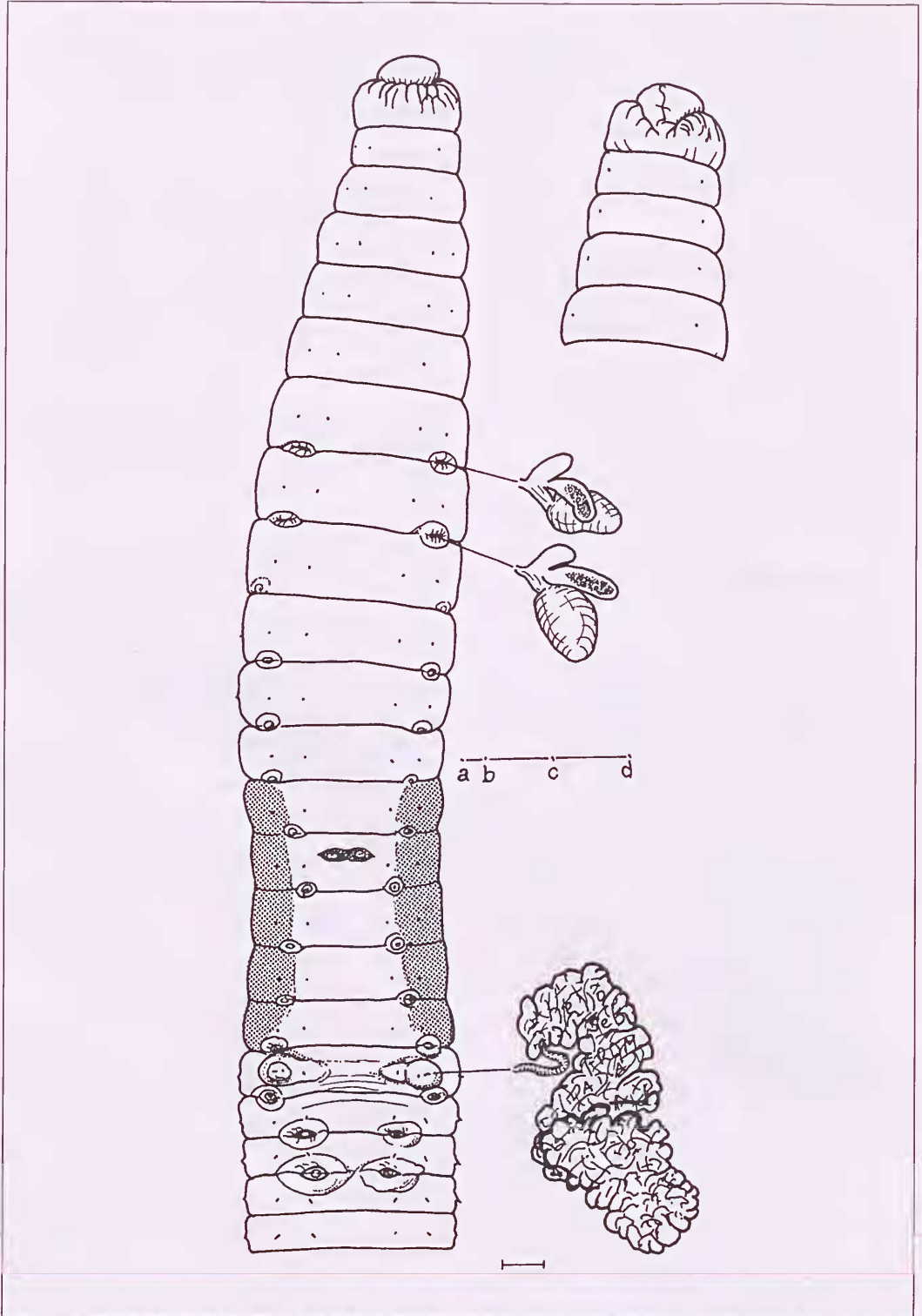


Figure 13. *Aporodrilus dombrovskii* gen. et sp. nov. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore with penial setae; plus view of prostomium.

Aporodrilus monogynus sp. nov.

Cryptodrilus polynephricus urethrae (part.) Jamieson, 1974, pp. 288–91, figs 23A, 24C, 31K–L

MATERIAL EXAMINED

HOLOTYPE:

14:3331 (H), Island Road, Lake Gordon south, 438800 5258900, 310 m, 14.4.1996, R. J. Blakemore, in humus of Huon pine forest, (mature posterior amputee, dissected and figured, fig. 14).

PARATYPES:

- 14:3437** (P1), Maria Creek, Lake Pedder, 442000 5250600, 310 m, 11.4.1996, R. J. Blakemore, in litter under *Eucalyptus nitida* woodland, (mature, dissected and figured, fig. 15).
14:3398 (P2), same details as H, (mature lacking tail).
14:3399 (P3), same details as H, (mature, dissected).
14:3400 (P4), same details as H, (mature).
14:3401 (P5), same details as H, (subadult).
14:3402 (P6), same details as H, (an immature plus 2 unregistered tails).
14:3428 (P7), Bonnet Bay, Lake Pedder, 431150 5248260, 310 m, 12.4.1996, R. J. Blakemore, M. Driessen, M. Anderson, T. J. Kingston, Ti-tree along creek, (mature, dissected plus several unregistered immatures and bits).
14:3438 (P8–P9), same location as P1, (two matures).
14:3439 (P10–P13), same location as P1, (4 immatures).
14:3458 (P14), same details as P7, (mature).

OTHER MATERIAL EXAMINED

- BM(NH): 1973:2:24**, Arve Valley, 146°50'E 43°05'S, 16 km from Geeveston, 11.11.1955, J.L. Hickman, labelled 'P1', (mature, dissected).
TM:K343, Arve Valley, 16 km from Geeveston, 146°50'E 43°05'S, 11.11.1955, J. L. Hickman, labelled 'P3', (mature, previously dissected, but only after clitellum).
TM:K344, same details as K343, labelled 'P4', (mature, undissected).
TM:K345, same details as K343, labelled 'P5', (mature, undissected).
TM:K346, same details as K343, 'P22', (mature, dissected).
TM:K347, same details as K343, 'P23', (a clitellate mature, undissected).
TM:K348, same details as K343, 'P24', (mature, undissected).
TM:K349, same details as K343, 'P25', (mature, undissected).
TM: unregistered, same details as K343, possibly the missing 'P26', (mature, undissected).

MATERIAL NOT EXAMINED

AM:W5313, Florentine, 4.8.1955, J. M. Gilbert, rainforest soil, 'P8', (this specimen is figured in Jamieson, 1974, fig. 23A with a single female pore).

AM:W5317, Florentine Valley, 14–19? 8.1955, J. M.

Gilbert, under pieces of wood and bark, 'P12', (this specimen is stated by Jamieson, 1974, p. 290 to have a single female pore).

EXTERNAL FEATURES

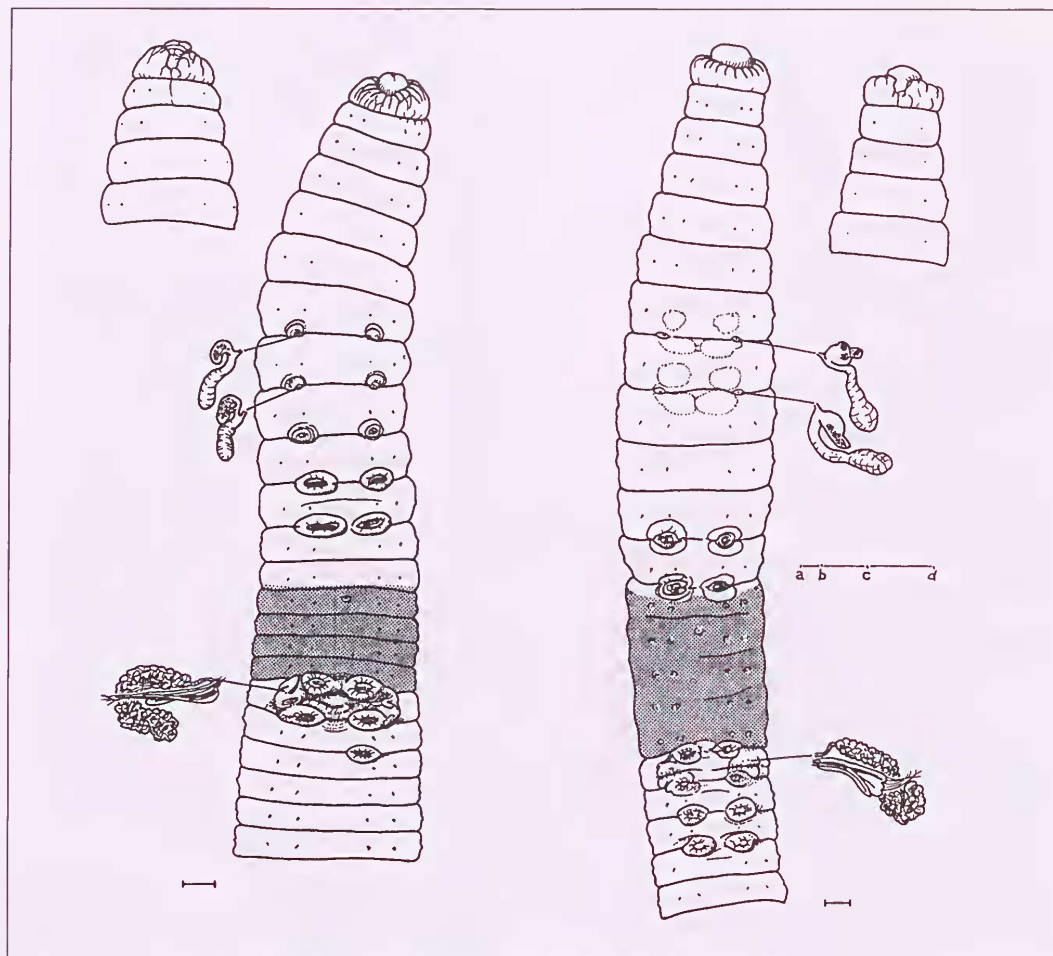
Body long with tail blunt and dorsally furrowed. Lengths mm: (H) 80+, (P1) 200, (P3) 180, (P4) 150, (P7) 170, (P9) 140, (P14) 180; normal range 110–200. Width: c. 7 mm. Segments: (P1) 132, (P3) 134. Colour: dark dorsum to lateral lines anteriorly but recedes to a faintly pigmented spine posteriorly, tail also dark, clitellum tan. Prostomium: epilobous only faintly tanylobous and closed (epi-tanylobous?). Clitellum: $\frac{1}{2}$ 13, 14– $\frac{1}{2}$ 17, 17. Dorsal pores: absent, Setae: 8 in regular rows, small in the anterior. Nephropores: not seen. Spermathecal pores: 7/8/9 in setal a line. Female pore: always single, midventral on 14. Male pores: paired in ab, near to penial setae. Genital markings: pairs of pale, shallow discs in line with spermathecal pores, postsetally in some or all of 7–9 often present (sometimes lacking); pairs of larger discs in a lines, but extending towards mid-ventral line, in 10/11 and/or 11/12 and 12/13; 2 pairs of discs in 17/18 and 18/19 just median to male pore lines; sometimes additional paired discs (or an analogue as in H) median to a lines in 19/20 and 20/21. All TM and BM specimens agree with the above range of genital marking variations and all have a single female pore.

INTERNAL ANATOMY

Septa: delicate, none especially thick. Gizzard: solid, barrel-shaped in 5 but displaced posteriorly to 7–8. Oesophagus: not especially dilated. Nephridia: avesculate merioic; not tufted anteriorly but larger and flattened in 1–6; about five–ten per side, equatorial, none especially enlarged; funnels not found; in tail segments about four or five small tubules per side, only the innermost having pre-septal funnel and sending duct to the succeeding segment. Vascularization: hearts in 10–13 with connections to supra-oesophageal vessel in 9–13. Spermathecae: two pairs in 8 and 9, ampulla elongate and with small pican-shaped diverticulum. Male organs: holandric iridescent testes and funnels in 10 and 11 in mucus; seminal vesicles racemose, small or rudimentary in 9, larger in 11 and 12 on anterior septa. Ovaries: palmate in 13; ovisacs not found in 14. Prostates: tubuloracemose 18–19, 20; penial setae present. Intestine: origin 16 but sometimes pushed forwards as far as 13; no typhlosole; gut contents, yellow soil, woody organic matter and a few grits.

REMARKS

These specimens would formerly have been part of a *Cryptodrilus polynephricus* Spencer, 1895 complex of Jamieson (1974), fitting within the wide range of variation permissible in his *Cryptodrilus polynephricus urethrae* sub-species. However, specimens referred to *Aporodrilus monogynus* are differentiated by a single female pore, genital markings within the range of variation given above, and lack of a typhlosole. They are, nonetheless, morphologically similar to, and often



Figures 14 and 15. *Aporodrilus monogynus* sp. nov. Fig. 14. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore with long penial setae; plus view of prostomium. Fig. 15. Similar views of (P1).

sympatric with, the holotype and remainder of specimens of *C. polyneplricus urethrae*, differentiated mainly by their paired female pores and rudimentary typhlosome, here designated *Aporodrilus urethrae* (Jamieson, 1974) comb. nov.

There are several inconsistencies in Jamieson's account and figures of specimens of his '*Cryptodrilus polyneplricus urethrae*'. Regarding possession of single or paired female pores: the single female pore in his specimens P5, P22, P23, P24 and P25 are not noted. Moreover; accounts of the distributions of genital markings are sometimes confused, for example, Jamieson (1974, p. 290) lists specimen 'P8' as not having genital markings in 17/18 and as having genital markings in 20/21 and 21/22, the opposite to his figure 23 of this specimen. (Jamieson's specimen P26, which is constantly referred to, is unregistered.) Jamieson (1974) was also contradictory on the presence or absence of a typhlosome (which on page 289 he states is absent or rudimentary in 'paratype 1 and holotype, respectively'; while on page

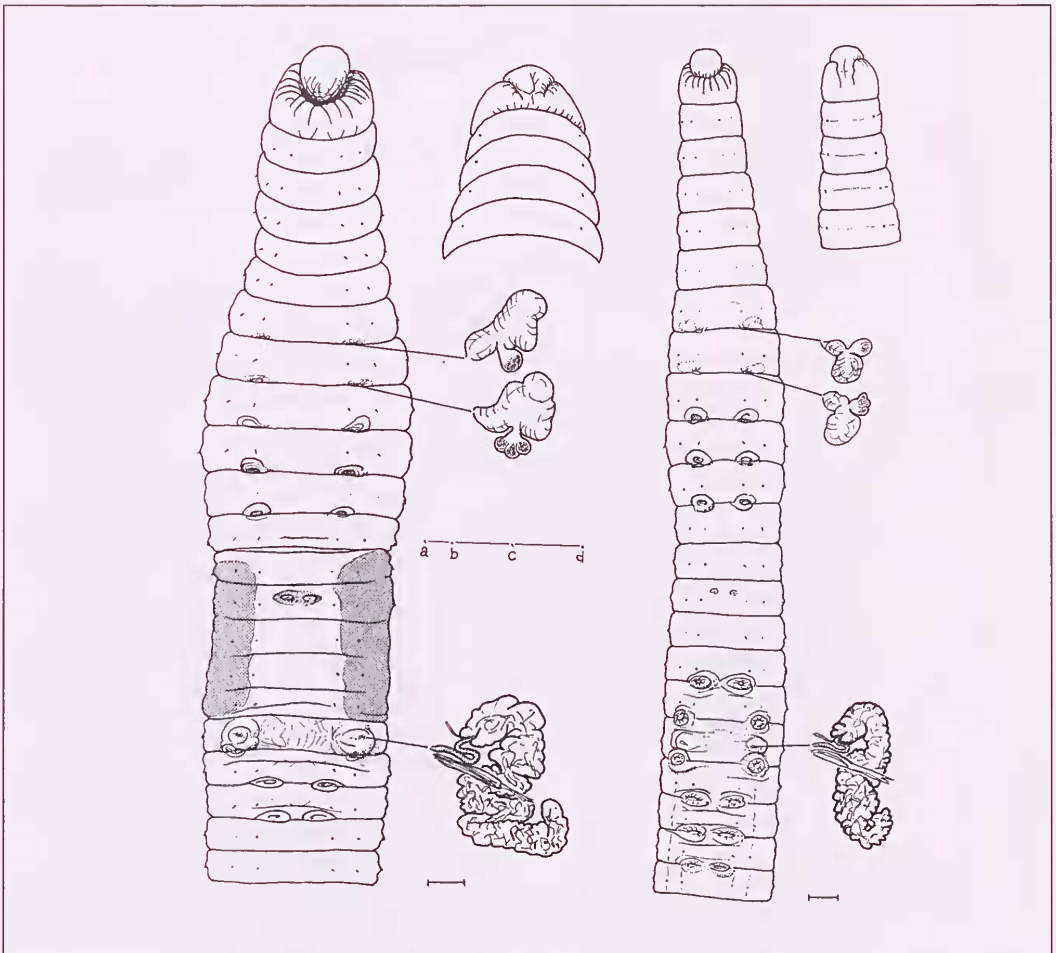
290 states 'a typhlosome is absent or rudimentary in the holotype and paratype, respectively'). In actuality, the typhlosome is rudimentary in *A. urethrae* (i.e. 'H') but absent from *A. monogynus* (i.e. 'P1').

Following Jamieson (1972b), *Cryptodrilus* is restricted to species with multiple nephridial bladders in a segment (Jamieson, 1974, p. 268 revised his earlier view and emended the definition of *Cryptodrilus* to include avascular species, a decision not supported here). Lack of nephridial bladders separates species of *Notoscolex* from *Cryptodrilus*, further lack of dorsal pores separates species of *Aporodrilus* from *Notoscolex* s. lat.

ETYMOLOGY 'monogynus' for the single female pore.

DISTRIBUTION AND HABITAT

Lake Gordon, Lake Pedder and Arve (and Florentine) Valleys, from litter and humus in forest soils.



Figures 16 and 17. *Aporodrilus rubicundus* sp. nov. Fig. 16. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore with long penial setae; plus view of prostomium. Fig. 17. Similar views of (P10).

Aporodrilus rubicundus sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3342 (H), Coronets, Lake Pedder east, 437900 5263100, 310 m, 11.4.1996, R. J. Blakemore, in Banksia / Ti-tree woodland on lake edge, (a mature specimen, in two halves, dissected and figured, fig. 16).

PARATYPES:

- 14:3339** (P1), Sprent Basin, Lake Pedder, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, in Banksia / Ti-tree on lake edge, (mature, dissected).
14:3347 (P2), Bell Basin, Lake Pedder, 310 m, 6.4.1996, A. Osborne and N. Forteach, (mature).
14:3343 (P3), same details as (H), (subadult).
14:3344 (P4), same details as (H), (juvenile).

- 14:3345** (P5–P6), same details as (H) (two immatures).
14:3419 (P7–8), Ti Tree Cove, Lake Pedder, 445500 5235400, 310 m, 8.4.1996, T. J. Kingston, in matted roots and litter on lake's edge, (two matures, one dissected).
14:3421 (P9), same details as (P7–8), (a subadult, plus an unregistered tail).
14:3420 (P10), same details as (P7–8), (a clitellate mature, dissected and figured, fig. 17).

EXTERNAL FEATURES

Tail club-shaped. Lengths mm: (H) total 120, (P1) 120, (P2) 85, (P3) 80, (P4) 75, (P5–P6) 50, (P7) 30, (P9) 110, (P10) 135. Width: c. 5 mm. Segments: (H) total 134, (P1) 130, (P2) 108, (P3) 88, (P5) 124, (P6) 101, (P7) 122, (P10) 122. Colour: bright red dorsum with blue cuticular iridescence to lateral c lines anteriorly (preclitellar segments paler), to only dd posteriorly; ventrum pale; clitellum orange. Prostomium: open or faintly closed epilobous, furrowed. Clitellum: 13, 14–17, saddle-shaped.

Dorsal pores: absent. Setae: 8 in regular rows, distinct as white dots. Nephropores: white intersegmental dots in c and d lines (at least). Spermathecal pores: 7/8/9 in setal a lines with pale anterior rims. Female pores: widely paired on 14. Male pores: paired in b lines near to penial setae. Genital markings: paired in line with spermathecal pores posteriorly in 9, 10–11, 12; sometimes paired (or an analogue) median to aa in 15/16 or 16/17; paired in line with male pores (in several specimens) in 17/18 and (in most specimens) in 18/19 followed by pairs of eye-like markings in some or all of 19/20–21/22, median to a setal lines.

INTERNAL ANATOMY

Septa delicate. Gizzard: muscular, barrel-shaped with anterior flange in 5. Oesophagus: dilated, vascularized and internally rugose in 8–13, but not calciferous. Nephridia: avesculate meroic; enlarged as tufted or 'peptonenphridia' in 3; thereafter about 3 or 5 clumps of tubules per side, equatorial approximately in line with setae plus one more dorsal; none especially enlarged; funnels not found. Vascularization: hearts in 10–12 from supra-oesophageal vessel in 8–12, 13. Spermathecae: 2 pairs in 8 and 9, duct thick, ampulla ovoid with a stubby or multilocular (cauliform), diverticulum at junction. Male organs: holandric iridescent testes and funnels in 10 and 11 in mucus; seminal vesicles small, racemose in 9 (and 11?), lingular in 12. Ovaries: palmate in 13. Prostates: tubuloracemose, tortuous in 17, 18–20, 21; penial setae present. Intestine: origin 16; no typhlosole; gut contents organic soil and woody material.

REMARKS

Lack of nephridial bladders and dorsal pores but with intestinal origin in 16 places this species in *Aporodrilus*. Formerly, *Aporodrilus rubicundus* would have been part of a *Cryptodrilus polynephricus* complex of Jamieson (1974), especially similar to *Aporodrilus avesciculatus* (Jamieson, 1974) from which it differs in having genital markings in 18/19 lateral of male pores; *Aporodrilus enteronephricus* (Jamieson, 1974) from which it differs in not having a deep typhlosole; and *Aporodrilus urethrae* (Jamieson, 1974) from which it differs in not having last hearts in 13. Other distinctive characters of *A. rubicundus* are the bright red colour, saddle-shaped clitellum and the shape of the spermathecal diverticula.

ETYMOLOGY 'rubicundus' for the red colouration.

DISTRIBUTION AND HABITAT

Widespread around Lake Pedder, apparently allopatric with *A. monogynus*, in organic soil under *Banksia* and *Leptospermum* spp. scrub.

Gastrodrilus driesseni gen. et sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3332 (H), Cripps Point, Lake Pedder, 429000 5242900, 310 m, 12.4.1996, M. Driessen, creek bank under trees, (a mature specimen, dissected and figured, fig. 18).

PARATYPES:

- 14:3333** (P1), same details as H, (mature, dissected).
14:3334 (P2), same details as H, (a mature specimen).
14:3346 (P3), Coronets, Lake Pedder shore at 437900 5248800, 310 m, R. J. Blakemore, 11.4.1996, under button grass on shoreline, (a mature posterior amputee).
14:3348 (P4), Scotts Peak, Lake Pedder south, 444300 5234300, 310 m, 17.4.1996, R. J. Blakemore, from creek opposite hut in sandbars, (a mature specimen, dissected).
14:3349 (P5), same details as P4, (a mature specimen).
14:3350 (P6), same details as P4, (six immature specimens, one dissected).
14:3356 (P7), Mt Solitary, Lake Pedder, 438000 5244500, 310 m, 11.4.1996, R. J. Blakemore and T. J. Kingston, in button grass at 20–30 cm depth and from loose pebbles and debris on shore, (a mature specimen, dissected).
14:3357 (P8), same details as P7, (a mature specimen).
14:3358 (P9), same details as P7, (mature, dissected).
14:3359 (P10), same details as P7, (two anterior portions of matures, one dissected).
14:3360 (P11), same details as P7, (an immature specimen).
14:3361, same details as P7, (a cocoon, figured fig. 18).
14:3405 (P12–P18), Coronets, Lake Pedder, 437900 5248800, 310 m, 11.4.1996, R. J. Blakemore and T. J. Kingston, under button grass on lake edge, (seven specimens: 2 mature posterior amputees, 3 subadults, 2 immatures and an unregistered tail).
14:3407 (P19), Sprent Basin, Lake Pedder north, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, under tea tree litter, (a mature posterior amputee).
14:3408 (P20), same details as P19, (a mature posterior amputee, dissected).
14:3409 (P21), same details as P19, (a complete subadult).
14:3457 (P22–P23), same details as P19, (4 mature specimens, one dissected).
14:3363 (P24), Stillwater below Hermit, Lake Pedder east, 428200 5258200, 310 m, 14.4.1996, R. J. Blakemore, under stones on shoreline, (mature, dissected).
14:3364 (P25), same details as P24, (4 mature specimens, one tail-less, plus a tail).
14:3404 (P26), Bell Basin, Lake Pedder north, 310 m, 7.4.1996, N. Fortcath and A. Osborne, under Huon pines, (a mature specimen, dissected).

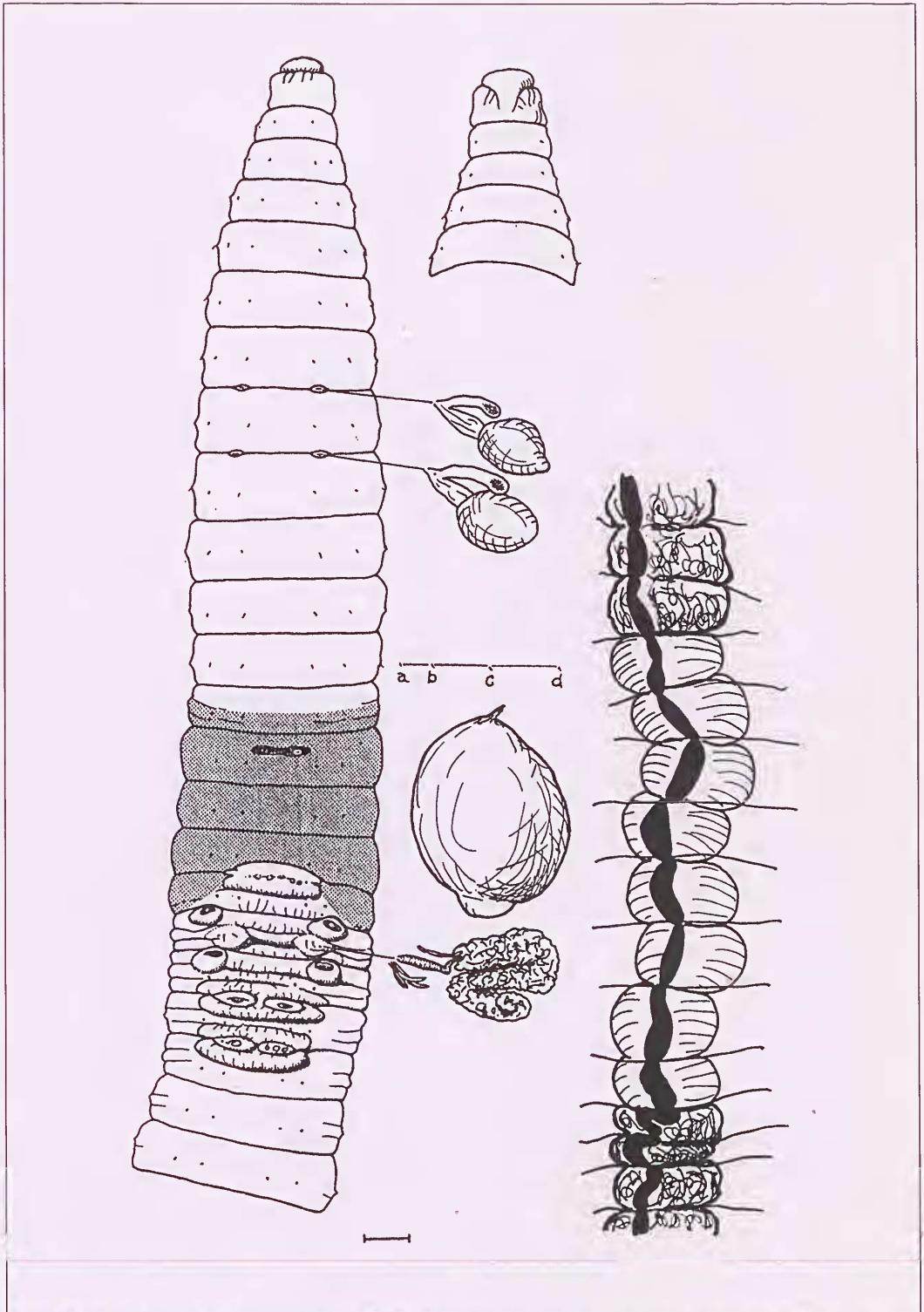


Figure 18. *Gastrodrilus driesseni* gen. et sp. nov. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore with penial setae; plus dorsal views of intestinal gizzards in 22–29, prostomium and a cocoon.

- 14:3423** (P27), same details as P19, (a mature posterior amputee plus 2 immatures).
14:3429 (P28), same details as P19 but under button grass, (a mature).
14:3430 (P29), Maria Creek west, Lake Pedder, 441700 5251000, 310 m, 11.4.1996, R. J. Blakemore and T. J. Kingston, in sand in creek bed, (a mature specimen).
14:3434 (P30), same details as P29, (6 immatures).
14:3422 (P31), Sprent Basin, Lake Pedder, 417600 5263100, 310 m, 9.4.1996, R. J. Blakemore and T. J. Kingston, under Ti-tree on edge of lake, (a damaged subadult).
14:3484 (P32–36), same details as P31, (5 specimens, a mature posterior amputee, dissected; a juvenile posterior amputee, 3 immatures and an unregistered tail).

EXTERNAL FEATURES

Lengths mm: (H) 130; (P1) 155; (P2–P9, complete matures) 95–145. Width: c. 4 mm. Segments: (H) 110; (P4) 133; (P7) 104; (P11) 147, (P26) 105. Colour: pale unpigmented or with a yellow tinge; clitellum buff. Prostomium: open epilobous (sometimes appearing closed). Clitellum: $\frac{1}{2}$ 13– $\frac{1}{2}$ 17, 17. Dorsal pores: absent. Setae: 8 in regular series. Nephropores: sometimes seen in a, c, mid-cd, and dorsal of d. Spermathecal pores: 7/8/9 in, or just lateral to, a lines. Female pores: widely paired 14. Male pores: paired on 18 near b lines and lateral of protruding penial setae, on low mounds. Genital markings: a conjoined pair of pads in aa in 13/14 anterior to the female pores (in Stillwater and some Bell Basin specimens), an elongate pad with faint discs between aa in 16/17 (absent in all Mt Solitary and Stillwater specimens and some Coronets and Bell Basin specimens); in most specimens—paired discs (shaped like parentheses in Mt Solitary specimens) just wider than male pores in 17/18; common to all matures—paired discs in b lines in 18/19 and paired, elongate and convergent discs midventral in 19/20 within tumid pads, often repeated in 20/21 too.

INTERNAL ANATOMY

Septa delicate, none especially thick. Gizzards: small, weak or vestigial in 5; large, moniliform intestinal gizzards from 22 to 28–31 (i.e. 7–10 of). Oesophagus: dilated but not calciferous in 10–13. Nephridia: avesculate meroic; few in number, not tufted anteriorly; three or four simple tubules converge in b lines, other tubules are often in c and/or d lines too; funnels not seen. Vascularization: large hearts in 10–12, smaller vessels in 9 (and sometimes 13); supra-oesophageal vessel in 7–13. Spermathecae: 2 pairs in 8 and 9, ampulla spherical or bulb-shaped; diverticulum clavate longer than duct (in Mt Solitary, Stillwater and Bell Basin specimens, extending beyond middle of ampulla). Male organs: holandric iridescent funnels in mucus in 10 and 11; seminal vesicles small, vestigial or absent from 9, large and racemose in 12. Ovaries: palmate in 13. Prostates: tubuloracemose, reflexed in 18, pink in colour; short penial setae present. Intestine: origin $\frac{1}{2}$ 16, dark and dilated in $\frac{1}{2}$ 16–21 then,

from 22, replaced by smooth, moniliform, gizzards numbering between 7 and 10; no typhlosome although a low dorsal ridge present from 30 or 31 after the intestine recommences; gut contents colloidal soil, dark or woody organic matter and, usually, many white quartzite grits.

REMARKS

Gastrodrilus driesseni is the type species of the genus. It may be differentiated from specimens of *Cryptodrillus dartnalli* Jamieson, 1974 (found by the present author to have intestinal gizzards), by its genital field, last hearts in 12, and intestinal origin in $\frac{1}{2}$ 16. *Gastrodrilus* is separated from *Nexogaster* Blakemore, 1997a (the only other Australian genus known to have moniliform intestinal gizzards, but here between segments 22, 23–27), through its lack of dorsal pores, lack of typhlosome and the form of the prostates. In *Nexogaster* the prostates are racemose (rather than tubuloracemose as in *Gastrodrilus*) and it is probable that this genus shares ancestry with *Notoscolex*, its intestinal gizzards being apomorphic. Similarly, *Gastrodrilus* may be related to *Aporodrillus* (i.e. lacking dorsal pores) or derived from a cryptodrilid that has lost nephridial bladders. In either case, the intestinal gizzards numbering between 7 or 10 are an acquisition that separates it from other genera. The numerous grits occurring in the gut probably assist comminution of food as it passes through the muscular gizzards.

Yellow cocoons were sometimes found with the specimens. A cocoon from Mt Solitary is illustrated and is attributed to *G. driesseni*, as, apart from this species, only a much smaller *Vesiculodrillus* species (*V. ventralis*?) was found at this site.

ETYMOLOGY in honour of Dr M. Driessen, TWWHA zoologist.

DISTRIBUTION AND HABITAT

Widespread and abundant around shoreline of Lake Pedder, in moist or waterlogged peaty or sandy-loam soils under button grass *Gymnoschoenus sphaerocephalus*, humus under Ti-tree *Leptospermum* spp. woodland, or in sand at the water's edge. (Possibly also from New Harbour, south-west Tasmania but material from this location still being researched).

Anisochaeta clavi sp. nov.

MATERIAL EXAMINED

HOLOTYPE:

14:3468 (H), Sprent Basin, Lake Pedder north, 417600 5263100, 310m, 9.4.1996, R. J. Blakemore, under Ti-tree litter at edge of the lake, (a mature specimen, dissected and figured, fig. 19).

PARATYPES: none.

EXTERNAL FEATURES

Pharynx everted and cuticle detached intersegmentally, especially in anterior (due to methods of preservation?),

body tapers to tail. Length mm: (H) 35. Width: c. 2 mm. Segments: (H) 75. Colour: shades of brown, darker dorsally, setal lines paler appearing to form stripes, clitellum beige. Prostomium: open epilobous, not furrowed; peristomium not cleft. Clitellum: saddle-shaped, $\frac{1}{2}$ 13– $\frac{1}{2}$ 17. Dorsal pores: from 6/7. Setae: 22 on 12 and 20, increasing to c. 30 posteriorly, mostly in straight lines but some irregularities. Nephropores: not obvious, possibly in bc and gh on clitellum. Spermathecal pores: 7/8/9 in b lines. Female pore: single, mid-ventral on 14. Male pores: paired on low mounds near b. Genital markings: paired discs in b in 16/17; an analogous on lhs in a in 17/18; paired in b in 18/19.

INTERNAL ANATOMY

Gizzard: vestigial, not muscular and same width as oesophagus in 5. Oesophagus: increasingly dilated and internally lamellate in 6–13, narrows in 14 to form valve in 15. Nephridia: avesculate microic, two nephridia per side per segment, the innermost has a pre-septal funnel

and discharges in about c line, the other nephridium appears to collect from the first nephridium (which it overlays) and exits via a long duct in about h line. Vascularization: hearts in 10–12 with connectives to supra-oesophageal vessel in 9–12. Spermathecae: 2 pairs in 8 and 9, ampulla spherical, diverticulum small with stalk bent to terminal bulb. Male organs: holandric, testes and funnels iridescent in mucus in 10 and 11; seminal vesicles absent from 9, racemose in 12. Ovaries: with many egg strings in 13, funnels converge in body wall; no ovisacs. Prostates: tubuloracemose, confined to 18; no penial setae seen. Intestine: origin 16; no typhlosole; gut contents organic matter.

REMARKS

This species is unique in the genus with its distinctive colour and setal patterns, small size, vestigial gizzard, 2 pairs of nephridia per segment, single female pore, saddle-shaped clitellum and seminal vesicles in 12 only. (It shares several of these features with *Woodwardiella tessellatus* (Spencer, 1895) which, however, is holoic and has only 8 setae per segment and racemose prostates).

ETYMOLOGY 'clavi' with stripes.

DISTRIBUTION AND HABITAT

Rare: north Lake Pedder, in humus in woodland on shoreline.

Anisochaeta clavi (Fletcher, 1887) comb. nov.

Perichaeta dorsalis Fletcher, 1887, pp. 618–20

Perichaeta dorsalis; Fletcher, 1890, pp. 1015–17; Spencer, 1893, p. 26, figs 58–60

Megascolex dorsalis; Beddard, 1895, pp. 376–77; Sweet, 1900, pp. 118–19; Michaelsen, 1907: 15; Buchanan, 1909, pp. 72–73, Pl. 15, fig. 12; Bage, 1910, pp. 225–27; Raff, 1910, pp. 249–50, Pl. 1, figs 9–10

Gemascolex dorsalis; Jamieson, 1974b, p. 87

TYPE MATERIAL: syntypes AM: W1399–1401 (not inspected).

TYPE LOCALITY: Warragul (and Eltham), Vict.

MATERIAL EXAMINED

SPECIMENS:

14:3455, Strathgordon village, Lake Pedder, 13.4.1996, R. J. Blackmore, in garden soil especially under rocks, (9 specimens: 4 matures, one a posterior amputee, one dissected; 4 immatures, and a cocoon).

14:3453, St Mary's Hotel, EQ987 959, 3.8.1993, R. D. D'Orazio and M. Cooper, (2 mature specimens, one dissected providing the description and illustration, fig. 20).

14:3454, Devonport, 9.7.1991, Field Naturalists Collection, (2 mature specimens, one dissected)

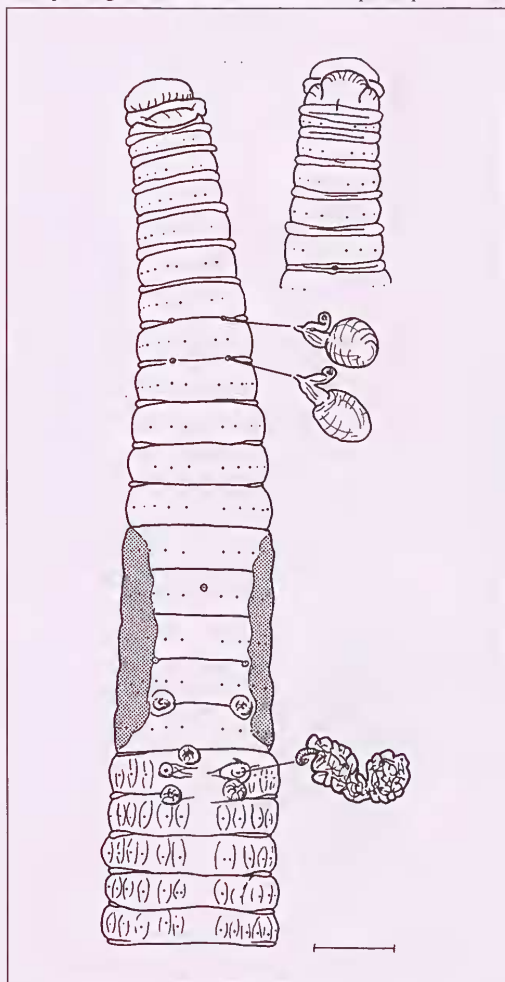


Figure 19. *Anisochaeta clavi* sp. nov. Ventral view of (H) showing *in situ* spermathecae, prostate ducting to male pore, plus view of prostomium showing first dorsal pore.

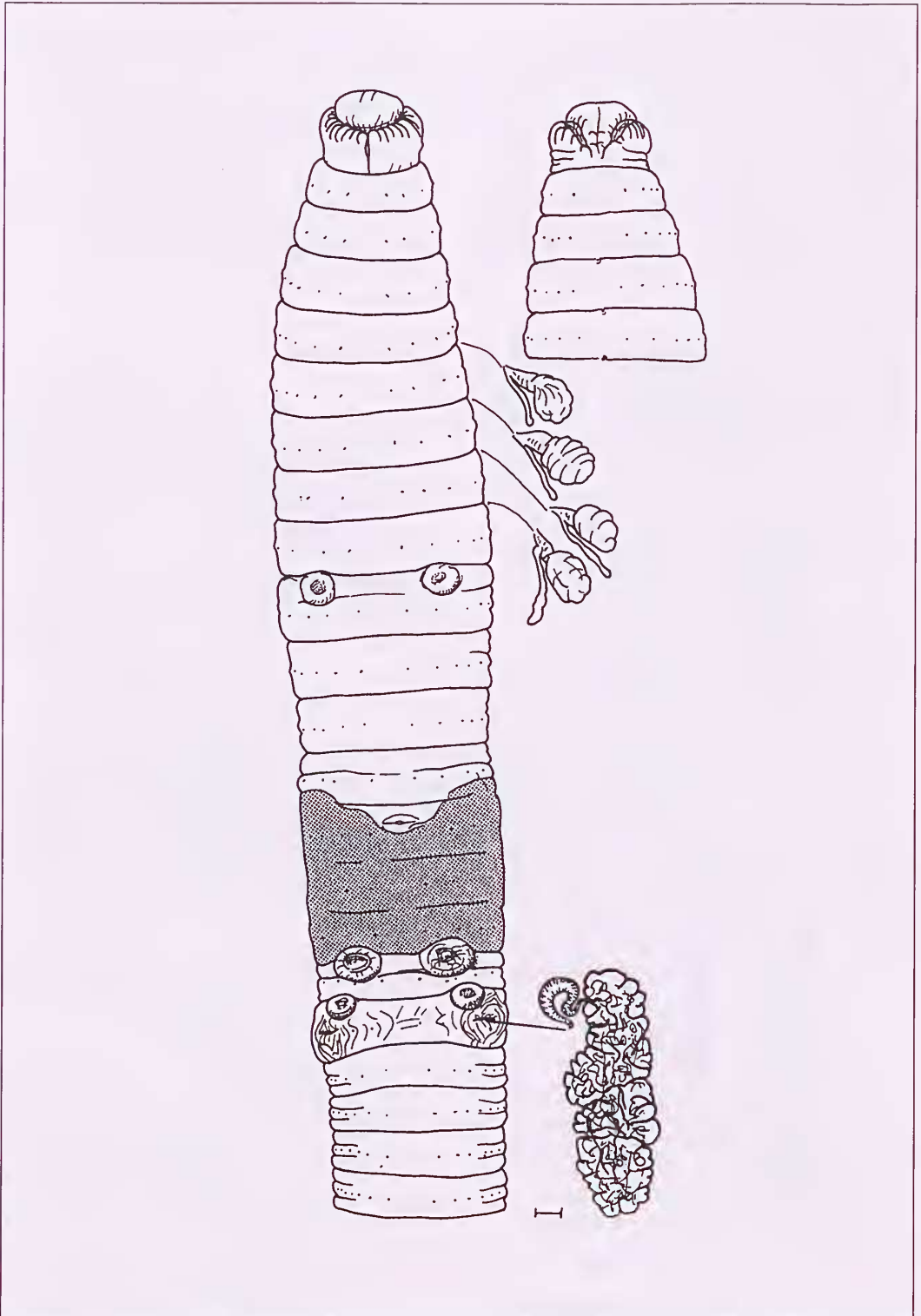


Figure 20. *Anisochaeta dorsalis* (Fletcher, 1887) comb. nov. Ventral view of 14:3453 showing *in situ* spermathecae to dorsal spermathecal pores, prostate ducting to male pore, plus view of prostomium showing dorsal pores.

14:3597, Rocherlea council depot, Launceston, 5.3.1997, R. J. Blakemore, on soil surface in morning, (mature).

EXTERNAL FEATURES

Body robust. Lengths mm: 160–250 (8 specimens). Width: c. 5.5 mm. Segments: 134–138. Colour: dorsum dark ruddy brown; ventrum, intersegments and setal aurioles pale, thus giving appearance of a dark spine between mid-dorsal setal gap; clitellum buff. Prostomium: tapering open epilobous, sometimes faintly closed and furrowed; peristomium cleft. Clitellum: annular, $\frac{1}{2}$ 13– $\frac{1}{2}$ 17. Dorsal pores: 4/5 (3/4 rudimentary). Setae: 24 on 12 and 20, increasing to 28–30 posteriorly where dorsal gap narrows. Nephropores: not found. Spermathecal pores: 5/6–8/9 lateral but moving more dorsally, in g/h lines in 5/6, in h/i lines in 8/9. Female pore: single, mid-ventral on 14. Male pores: widely paired on penes, often in deep copulatory bursae, sometimes everted; follicles but no setae seen between male pores. Genital markings: paired (or analogue) sucker-like pads in bc anteriorly in 10; large paired pads in a-b,c pre-setally in 17, encroaching on 16/17; smaller pads anteriomedian to male pores in 18.

INTERNAL ANATOMY

Gizzard: muscular barrel in 6 (with a large proventriculus in 5). Oesophagus: not especially dilated 7–15, valvular in 16. Nephridia: avascular meroic, bands of innumerable presetal tubules in each segment, flattened and tufted in 3–5, reducing in size after clitellum; none especially enlarged, funnels not found. Vascularization: hearts in 10–13 with connectives to supra-oesophageal and (single) dorsal blood vessels. Spermathecae: 4 pairs lateral in 6–9, ampulla sub-spherical on tapering duct, diverticulum long (non-iridescent). Male organs: holandric, testes and funnels iridescent in mucus in 10 and 11; seminal vesicles small in 9, racemose anteriorly in 11 and 12. Ovaries: large in 13; no ovisacs. Prostates: flattened, tubuloracemose 17, 18–23; no penial setae seen. Intestine: origin 17; no typhlosole but a low ridge from 18; gut contents organic matter.

REMARKS

These specimens conform to both Fletcher's and Spencer's descriptions of *Perichaeta dorsalis*, however, the gizzard is here confirmed in 6 (rather than in 5–6), the female pore is unpaired (agreeing with Fletcher, 1890) and the prostates are more extensive than 18–19. These variations cast little doubt on conspecificity.

According to some earlier definitions, all that surely separates *Gemascolex* from the prior genus *Anisochaeta* is the presence of intersegmental genital markings. As demonstrated here (and in Fletcher's type description) these markings are mainly on the anterior margins of the segments and only encroach on the intersegmental furrows.

DISTRIBUTION AND HABITAT

Widespread in Victoria (and South Australia if *Anisochaeta octothecata* (Jamieson, 1974b) is synonymous) and now Tasmania. This is the first record of this species in Tasmania, and the first record of an introduced endemic earthworm from Victoria. That most specimens were found in garden soils suggests a means of introduction, via potted plants—an often recorded means of translocation of species (Blakemore, 1999).

FAMILY LUMBRICIDAE

Aporrectodea caliginosa (Savigny, 1826)

MATERIAL EXAMINED

SPECIMENS:

14:3449, Strathgordon village, Lake Pedder, 13.4.1996, R. J. Blakemore, in garden soil, (mature, dissected, figured, fig. 21).

EXTERNAL FEATURES

Length mm: 80. Width: c. 3 mm. Segments: 138. Colour: pale, unpigmented, clitellum white. Prostomium: open epilobous. Clitellum: saddle-shaped, 28–34. Dorsal pores: 10/11 (9/10 rudimentary). Setae: 8, closely paired. Nephropores: only sporadically visible. Spermathecal pores: 9/10/11 lateral in c lines. Female pores: paired on 14. Male pores: widely paired, lateral slits on 15. Genital markings: tumescences surround setae ab in 9–11, 27, 30, 32–24; tubercula pubertatis 31–33, narrowing in mid-32.

INTERNAL ANATOMY

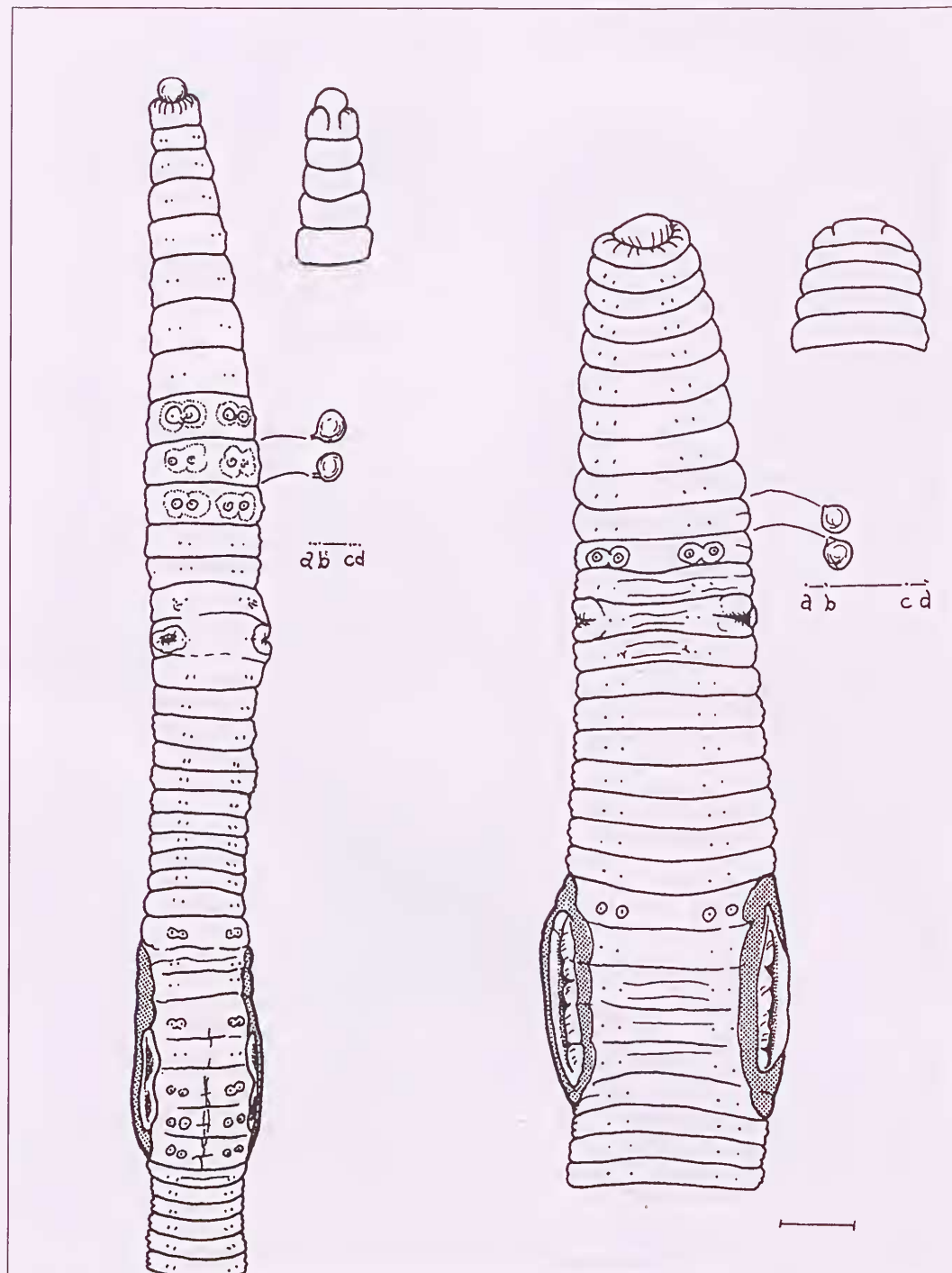
Septa: 5/6–10/11 thickened, septum 17/18 aborted. Oesophagus: dilated to form lateral calciferous pouches in 10. Nephridia: vesiculate holoic, bladders large, flattened and J-shaped. Vascularization: hearts in 6–12 (the last pair small). Spermathecae: 2 pairs lateral in 10 (transversing septum 9/10) and 11 (not iridescent). Male organs: holandric, testes iridescent in 10 and 11; seminal vesicles large in 9–12. Ovaries: compact in 13; small ovisacs in 14. Prostates: none. Gizzard: intestinal, large occupying $\frac{1}{2}$ 16–18, preceded by a large 'crop' in 15–16. Intestine: origin 19; typhlosole deep from 21, 22; gut contents rich sandy soil and some woody material.

REMARKS

This specimen is within the range of variation allowed for *Aporrectodea caliginosa* (e.g. Sims and Gerard, 1985—except they have typing error for clitellum extent of 'xxxi–xxxiv'), these authors provide a list of synonyms. Some authors refer this species to *Aporrectodea turgida* (e.g. Gates, 1972), and it is usually separated from its sibling species *A. trapezoides*, both have been reported from Australia in the past (Blakemore, 1999).

DISTRIBUTION AND HABITAT

Widespread, Western Palearctic and Eastern Nearctic, introduced into temperate regions of the world mainly in cultivation, fairly common in southern states of Australia. Its occurrence in a garden soil at Strathgordon is unremarkable.



Figures 21 and 22. Fig. 21. *Aporrectodea caliginosa* (Savigny, 1826) specimen 14: 3449 ventral view showing male pores on 15, *in situ* spermathecae and dorsal view of epilobous prostomium. Fig. 22. *Eiseniella tetraedra* (Savigny, 1826) specimen ex 14: 3451 ventral view showing male pores on 13, *in situ* spermathecae and dorsal view of epilobous prostomium.

Eiseniella tetraedra (Savigny, 1826)

MATERIAL EXAMINED

SPECIMENS:

14:3451, Scotts Peak, Lake Pedder south, 442700 5234800, 310m, 8.4.1996, T. J. Kingston, under stones and litter on sand, (11 mature specimens, one acitellate, one dissected and figured, fig. 22).

EXTERNAL FEATURES

Tail tapering and square with setal couples at each corner. Length mm: 30. Width: c. 3.5 mm. Segments: 83. Colour: anterior and dorsum chestnut brown with dark mid-dorsal line, clitellum pale. Prostomium: open epilobous. Clitellum: saddle-shaped, 22–27. Dorsal pores: 4/5 (3/4 rudimentary). Setae: 8, closely paired. Nephropores: not seen. Spermathecal pores: 9/10/11 above d lines. Female pores: paired on 14. Male pores: widely paired, lateral slits on 13. Genital markings: tumescences surround setae ab on 10 (and 22?); tubercula pubertatis ridges 23–25, 26. Elongate spermatophores were observed on several specimens attached around segment 20, but spermatozoal iridescence was not found.

INTERNAL ANATOMY

Oesophagus: calciferous pouches in 10. Nephridia: vesiculate holoic, bladders elongate. Vascularization: hearts in 7–12 (the last pair small). Spermathecae: 2 pairs dorsal in 10 and 11 (not iridescent). Male organs: holandric, although iridescent testes only found in 10 (obscured by seminal vesicle in 11?); seminal vesicles in 9–12. Ovaries: compact in 13; small ovisacs in 14. Prostates: none. Gizzard: intestinal in 17, preceded by a large 'crop' in 15–16. Intestine: origin 18; typhlosole deep from 20, 21; gut contents organic matter and a few grits.

REMARKS

These specimens conform to *Eiseniella tetraedra* as described by Sims and Gerard (1985). Some forms of this species have male pores, as is usual throughout biparental lumbricids, on 15.

DISTRIBUTION AND HABITAT

Widespread, Western Palaearctic, introduced into temperate regions of the world, often found in wet situations. Although this is the first record from Tasmania (except for Gates' report from Macquarie Island), this species is regularly found on mainland Australia (Blakemore, 1999).

Lumbricus eiseni Levinsen, 1884

MATERIAL EXAMINED

SPECIMEN:

14:3452, Strathgordon village, 13.4.1996, R. J. Blakemore, in garden soil, (mature, posterior amputee—dissected, figured, fig. 23).

EXTERNAL FEATURES

Lengths mm: (30–60). Width: c. 3 mm. Segments: (70–115). Colour: anterior and dorsum red-brown, clitellum buff. Prostomium: tanylobous. Clitellum: saddle-shaped, 24–32. Dorsal pores: 5/6. Setae: eight per segment, closely paired. Nephropores: irregular in b and above d. Spermathecal pores: none. Female pores: on 14. Male pores: widely paired, lateral slits on 15. Genital markings: none.

INTERNAL ANATOMY

Oesophagus: large annular calciferous sacs in 10 and 11. Nephridia: holoic. Vascularization: hearts in 6?, 7–11. Spermathecae: none. Male organs: holandric, testes and funnels in 10 and 11 (although non-iridescent in 10); seminal vesicles in 11 and 12. Ovaries: huge in 13; small ovisacs in 14. Prostates: none. Gizzard: intestinal in 16–18, preceded by large 'crop' in 15. Intestine: origin 19; typhlosole deep from 22; gut contents organic soil and a few grits.

REMARKS

The genus *Lumbricus* is distinguished by its tanylobous prostomium. Sims and Gerard (1985) provide a synonymy for this cosmopolitan species of European origin.

DISTRIBUTION AND HABITAT

Widespread in western Europe, in wet acid moorlands, occasionally reported from around the world. In the Australasian region, Gates (1972) reports *L. eiseni* from Stewart Island, NZ. This is a new record for Australia.

Octolasion cyaneum (Savigny, 1826)

MATERIAL EXAMINED

SPECIMENS:

14:3450, Strathgordon village, Lake Pedder, 13.4.1996, R. J. Blakemore, in garden soil, (3 specimens—2 matures, one dissected and figured, fig. 25, plus an immature).

EXTERNAL FEATURES

Body flaccid and tail spade-shaped. Lengths mm: c. 100. Width: c. 4.5 mm. Segments: c. 155. Colour: unpigmented, blue-grey with a lilac mid-dorsal line, calciferous gland and tip of tail show yellow, clitellum white. Prostomium: open epilobous. Clitellum: tumid, saddle-shaped, 29–34. Dorsal pores: 13/14. Setae: 8, widely-paired after clitellum. Nephropores: lateral of b.

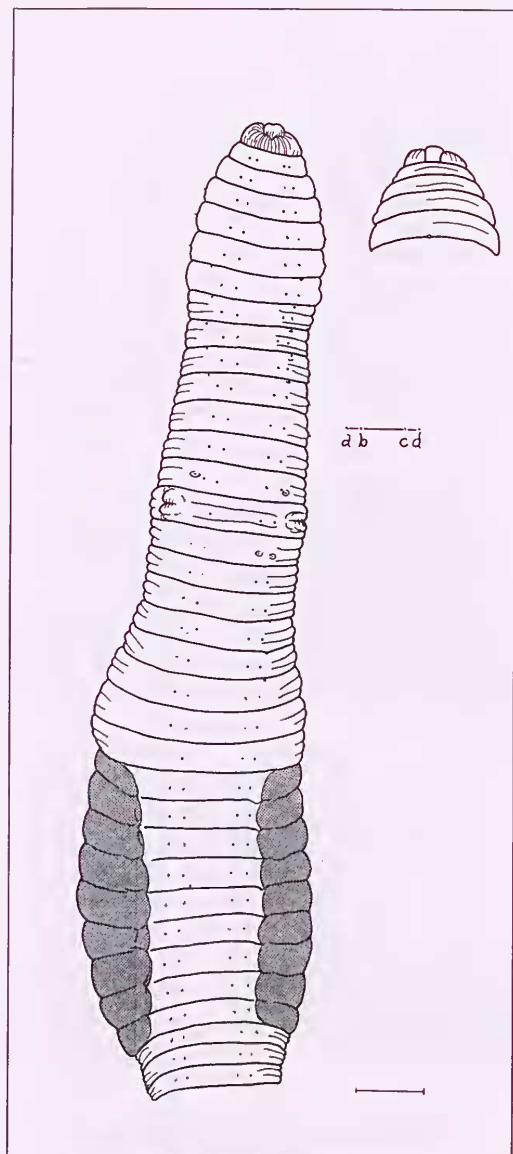


Figure 23. *Lumbricus eiseni* Levinsen, 1884 specimen 14: 3452 ventral view showing male pores on 15, and dorsal view of tanylobous prostomium.

Spermathecal pores: 9/10/11 in c lines. Female pores: on 14 lateral of b lines. Male pores: widely paired, lateral slits on 15. Genital markings: tumescences around ab in 8 and 9; tubercula pubertatis ridges 29, 30–33.

INTERNAL ANATOMY

Oesophagus: large annular calciferous glands in 10 and 11. Nephridia: holoic. Vascularization: hearts in 6–11. Spermathecae: 10 and 11. Male organs: holandric, testes and funnels in 10 and 11; seminal vesicles 9–12. Ovaries: compact in 13; small ovisacs in 14. Prostates: none.

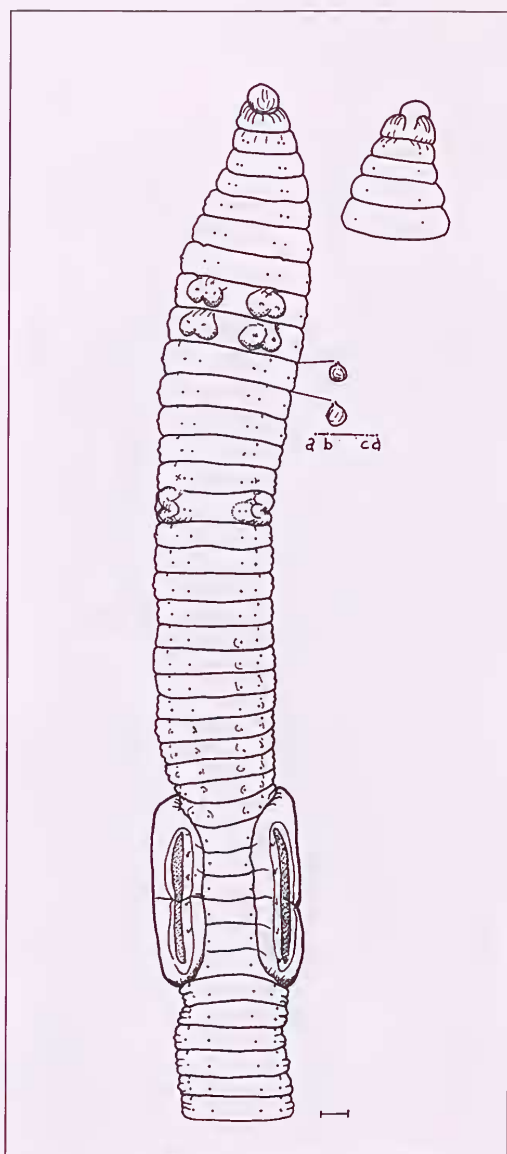


Figure 24. *Octolasion cyaneum* (Savigny, 1826) specimen 14: 3450 ventral view showing male pores on 15, *in situ* spermathecae and dorsal view of prostomium.

Gizzard: intestinal in 16–17, preceded by a large 'crop' in 15. Intestine: origin $\frac{1}{8}$ 18; typhlosome large from 21; gut contents organic soil and organic matter.

REMARKS

Sims and Gerard (1985) provide a synonymy.

DISTRIBUTION AND HABITAT

Europe, America and widespread. A common introduction to southern states of Australian, including Tasmania (Blakemore, 1999), especially in disturbed, moist soils.

DISCUSSION

The number of earthworm species described from the Tasmanian Wilderness World Heritage Area is more than doubled to approximately 30 species by the current study. The survey of Lake Pedder appears to demonstrate that this site is particularly species-rich with twenty-one earthworms. However, this situation probably relates more to the intensity of the collection effort and subsequent taxonomic treatment, than to actual biodiversity. Possibly the highest number of earthworm species reported from any one site in Australia was from a CSIRO agricultural research station in Queensland surveyed by the author over a period of three years: the 23 species comprised 16 exotics and only 7 native species (Blakemore, 1999). Whereas Lake Pedder has almost the opposite ratio of 16 natives and 5 exotics, attesting to its relatively undisturbed status, the relatively few exotic species are mainly confined to areas of human habitation or recreation. It is probable that more species may be located with further collecting, the huge area of the TWWHA can ultimately be expected to reveal considerable numbers.

A primary aim of the present study was to determine whether the 'Lake Pedder earthworm' was still present at Lake Pedder following its inundation for hydroelectric power generation in 1972. Initial inspection of the single type-specimen, allowing its redescription as *Hypolimnus pedderensis* (see above account), was followed by directed sampling around Maria Creek that once flowed to the original beach type-locality, and along newly formed beaches at the lake's edge. Although several of the new species described herein appear closely related, occupy a similar habitat, or superficially resemble *H. pedderensis*, none is conspecific. The original limnic, sandy habitat probably exerted strong selection pressures on *H. pedderensis*: the reductions of its dorsal pores and of anterior nephridia are adaptations found in several aquatic earthworms (e.g. *Pontodrilus*), and multiplication of gizzards is found elsewhere at Lake Pedder in the intestine of *Gastrodrilus driesseui*. As no specimens were found agreeing with *Hypolimnus pedderensis*, the inclusion of this species as 'endangered' in the Parks and Wildlife Service's *Interim list of native invertebrates which are rare or threatened in Tasmania* (Anon, 1994, p. 5) appears justified. This species is likely to be extinct due to inundation of its original and unique habitat and, if so, this is the first instance of loss of an endemic earthworm species from the world fauna.

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